

DISCOVERY

A Monthly Popular Journal of Knowledge

August 1936

One Shilling

IN THIS ISSUE

About Chameleons

By Dr. F. P. G. de Smidt

Archæology in Southern Spain

By M. La Trobe-Bateman

The Year's Excavations at Lachish : By E. N. Fallaize

Seed Dispersal of the Compositæ — Progress in Aerial Photography
Chinese Origins — Symbolism in Literature

FOYLES

Booksellers to the World

We can supply any book reviewed, mentioned or advertised in "Discovery."

119-125 CHARING CROSS ROAD, LONDON, W.C.2.

Telephone: GERRARD 5660 (12 lines).

CLASSIFIED ANNOUNCEMENTS

are accepted at 1d. per word (minimum 24 words). Discount allowed for series, particulars on application. Instructions should be sent (with cash) to the Advertisement Manager, "DISCOVERY," BOUVIERIE HOUSE, 154, FLEET STREET, LONDON, E.C.4.

EDUCATIONAL.

WYCHWOOD SCHOOL, OXFORD.—Recognised by Board of Education. Private School of 80 girls (ages 6 to 18); half boarders, half day-pupils. Run on modern lines. Small classes. Large staff of University standing. Development of individual character by freedom and co-operative government, but with old-fashioned standard of courtesy and consideration for others. Special attention paid to art, music, literature and civics. Sports: tennis, lacrosse, netball, boating and swimming. Exceptional health record. Elder girls prepared for the University. Entire charge with sea or farm holidays if desired. Fees: 150 guineas per annum for boarders; from 30 guineas per annum for day-pupils. Principals: Margaret Lee, M.A. (Oxon), University Tutor in English; Geraldine Coster, B. Litt. (Oxon).

MIDHURST GRAMMAR SCHOOL. New buildings just completed: Swimming bath, changing room, school library. New scale of fees, boarding and tuition fees, £60 p.a. inclusive. Preparatory Department for Boys of 8 to 10. For prospectus apply to Headmaster, Rev. B. Heald, M.A. (Oxon).

SCHOOL CERT. and ARMY. Quick easy way if LATIN taken for former only. Major Shaw, M.C., R.A., Milford-on-sea.

C.A., PROF., VET., LAW PRELIMS., etc., Coaching all Exams.; Lab. J. W. Gardiner, M.A., 254, Lauderdale Mansions, W.9. Abercorn 1646.

DR. WILLIAMS' School for Girls, Dolgelley, North Wales. Prospectus from Miss E. C. Nightingale, M.A.

THE Co-Principals of ROCKLANDS SCHOOL, HASTINGS, give maximum thought and care for the welfare of Junior Children, 5-14 years of age, for perfect bodily health and cultural education.

"HELIOPOLIS ACADEMY," GREAT YARMOUTH.—Ideal Private Boarding School for Senior Girls; most up-to-date methods in education, but no ultra-strenuous games; one minute from sea; fees moderate; foreign students taken: Apply Principal for Prospectus. University trained Staff.

SWITZERLAND—3,500 ft. La Citronelle. Chateau d'Oex Home School for Boys and Girls of Preparatory School age; fully qualified staff, tutors, mistresses—entire charge if desired. Special attention given to health. Winter sports—Excursions. Principal, Miss Adams.

TAUNTON SCHOOL, TAUNTON. Valuable Scholarships are offered annually in June. A number of bursaries are available for the sons of ministers, missionaries and clergy. For all particulars apply to the Head Master.

MISS C. JEANS coaches in French and German language and literature personally or by correspondence. Experienced in school work, preparation for examinations and for scholarships. Up-to-date methods and oral work. For terms, etc., apply Miss C. Jeans, Reidhaven, Earlswood Road, Redhill.

BRANKSOME, Godalming, Surrey. Boys' Preparatory School. First-class Education at moderate fees. Boarders only; six graduate staff, entire charge if required. Prospectus on request.

THE FROEBEL PREPARATORY SCHOOL, Colet Gardens, W.14. Nursery Class attached. Sound modern education for boys and girls from 2-14 years old.

SCIENTIFIC SUPPLIES.

FROGS, Axolotls, Reptiles, Guinea Pigs, Rats, Mice, Rabbits, Day-old Chicks, Crayfish, Proteus and other requirements for Biological Research and Scientific purposes. Can be supplied at short notice in large or small quantities. Write for illustrated list: Waterloo Goldfishery Co., 47 Gt. Guildford Street, London, S.E.1.

MANY GOOD SECONDHAND MICROSCOPES and objectives by best English and German makers at very reasonable prices. Stamp for list to: CHARDS, Pawnbrokers, Forest Hill, S.E.23.

MICROSCOPIC OBJECTS.—Prepared, unmounted. Assorted packet, 2/-. New Mounted Slides always in stock. Leng, 183, Manchester Drive, Leigh-on-Sea.

DICTAPHONES, GUARANTEED, Records, Service, from £15. Halves author's work. Dictating Machine Exchange, 24, Southwark Street, London, S.E.1, and Manchester and Leeds.

LEITZ (Dissecting) BINOCULAR MAGNIFIERS new condition (in two cases); high and low magnifications (low, $\times 3\frac{1}{2}$, $\times 7$, $\times 10\frac{1}{2}$; high, $\times 10$, $\times 20$, $\times 30$). Large field of view; rack and pinion motion. 3 Pairs Eyepieces, interchangeable. Stand with crosshead motion No. 283 (Leitz list). £10.—"W.", 64, Ninian Road, Cardiff.

HOLIDAY, TRAVEL & HOTELS.

BEWDLEY, WORCESTERSHIRE.—Redthorne Homestead; in centre glorious country. Great opportunities for Botanists, Entomologists, Artists, etc. Apply Misses Fox and Gillbanks.

BOURNEMOUTH. BRANKSOME DENE HOTEL. Fruitarian and Vegetarian. Delightfully situated in its own grounds. Write for illustrated brochure. Telephone 1104 and 4796.

BRIGHTON. "Glencoe" Private Hotel. 112, Marine Parade. Best position sea front. Large (covered) sun-lounge. Ideal family residence. Terms moderate. R. William Cave, M.B.E.

CALLANDER, PERTHSHIRE.—Trossachs Hotel, Trossachs. Bedrooms 60. Pens., fr. 5 gns. Lun., 3/6 and 4/6; Din., 6/-. Golf, fishing, tennis.

DOLOBRAN GUEST HOUSE, LEAMINGTON SPA. Comfortable, unpretentious; we welcome people of good standing from Archbishops to foreign Boy Scouts. From 3 gns.; 2½ gns. sharing. Lloyd, 151, Leam Terrace.

FITTLEWORTH, SUSSEX.—Fortrie Guest House. Real country. Comfort, good beds and cooking. Breakfast in bed if desired. Phone 61.

KESWICK, English Lakes. The Keswick Hotel. Bed., 100; Rec., 5, Pens., 5 gns.; 6 gns. season. W.E. fr. 15/- per day. Golf, tennis, boating, bowls, fishing.

MIEDERS-IM-STUBAI, Tirol; 3,100 ft. up; 10 miles Innsbruck; beautiful Alpine scenery. 7s. 6d.—8s. 6d. per day. Herr Beck, Hotel Lerchenhof.

RIVIERA.—SEA HOTEL, Cap Martin, facing full south in own grounds direct on Sea. Large roof terrace with magnificent views. Buses to Menton and Monte Carlo. Pension, special terms by arrangement

(Continued on page lxix).



DISCOVERY

A Monthly Popular Journal of Knowledge

Vol. XVII. No. 200. AUGUST, 1936.

PRICE 1s. NET

Trustees: SIR J. J. THOMSON, O.M., F.R.S., SIR F. G. KENYON, K.C.B., F.B.A., SIR A. C. SEWARD, Sc.D., F.R.S., DR. CYRIL BAILEY, F.B.A.

Editor: L. RUSSELL MUIRHEAD, M.A.

Publishers: BENN BROTHERS, LTD. All communications respecting editorial matters to be addressed to the Editor; all questions of advertisements and subscriptions to the Manager.

Offices: Bouverie House, Fleet Street, London, E.C.4. (Closed on Saturday.)

Telephone Central 3212. Telegrams: Benbrolish, Fleet, London. Annual Subscriptions 12s. 6d. post free anywhere in the world. Single numbers 1s. net; single back numbers more than two years old, 1s. 6d. net; postage (inland and foreign) 2d. Binding cases, price 2s. 6d. net each; postage 6d.

Notes of the Month.

WITH the closing of the academic year, the annual conference season, so dear to the hearts of a large section of the English-speaking races, has set in with renewed vigour. A meeting of very wide appeal was the Congress of the Universities of the British Empire, the fifth of its kind, which Mr. Stanley Baldwin, as Chancellor of the University and President of the Congress, opened at Cambridge on July 14th. After an exordium on the work of universities in general, and a judicious reference to benefactors, past, present, and possibly future, the Chancellor reminded his audience that Cambridge, notwithstanding its popular (and justified) reputation as a home of scientists and mathematicians, was, above all other seats of learning, the cradle of poets. Poets as a class did not do much harm, he reminded his hearers, and the equipment of a laureate was not as expensive as that of a research student. But the most important part of his address came at the end, when he adverted to the unhappy fact that academic freedom was no longer universal; it was the worthy task of the Universities of the British Empire to preserve this freedom at all costs, and to set a shining example which would dissipate the clouds of distrust that threatened the world to-day.

The Vice-Chancellor (the Master of Clare College), at a later meeting of the Congress, spoke a word in favour of co-ordination, referring to the vast spread of

specialised branches of knowledge, and the danger of reduplication of teaching. In his words we find a warning against the production of students who know "more and more about less and less," in other words, exclusive specialists, a major menace to European civilisation of the day; and we are glad to note that he had a kind word to say for the "pass degree" man. The tripos, in fact, was not everything. Lord Rutherford agreed that the cost of research students was high; but that if only one minor Faraday were produced every twenty years, the University had justified itself.

* * * *

Meanwhile, at University College, London, the World Congress of Faiths is following an interesting path. At the time of writing, it is too early to sum up the outcome of this remarkable Congress; whether it will effect a really material advance towards its ideal of "World Fellowship" must remain to be seen; but, in fact, the mere assembling of distinguished members of the Christian, Jewish, Buddhist, Moslem, and Hindu religions, as well as exponents of independent religious thought, is a great feat in itself. It is true that the delegates were chosen with a view to their ability to raise points for universal discussion and to follow up such discussion; and, therefore, must be reckoned among the most broadminded followers of their respective creeds. But, putting it at the lowest level, it is a good thing for the cause of world fellowship that the broadminded should be granted the publicity of such a congress. Universal fellowship is inevitably the ideal, however distant, of "men of good will" of whatever race or creed. Shall it prevail over the strong passions of national or religious fervour?

* * * *

Of more purely scientific interest was the 55th Annual Meeting of the Society of Chemical Industry, held at Liverpool towards the beginning of last month. Universality was again the keynote, struck by the address of Mr. W. A. S. Calder, the retiring President, who chose

as his subject "The Chemist as World Citizen." "The present state of the world," he said, "is one causing grave apprehension to all those of us who desire freedom and progress. One of the chief causes of the position in which all nations are involved appears to be the utter ignoring of facts. We chemists and engineers are forced by our training and in our daily work to face facts, and we acquire a possibly undue reverence for facts. We are fully aware of how difficult it is to obtain exact information and also how few are the facts that we really know with certainty." Could not the nations learn, he asked, as chemists inevitably learnt, that it was impossible to be always right? In the daily press we were always being threatened with "a chemist's war"; were we not far more likely to have "a politicians' war," or, if blazing headlines must appear entirely irrespective of their truth, why not the equally senseless phrase "A printers' war?" Actually, he went on to say, one of the most magnificent of the chemist's duties was the prevention of accidents, and especially the anticipation of risks whereby accidents might be avoided. Interchange of experience of accidents between several countries were already taking place; it was to be hoped that such pooling of knowledge might become world-wide.

* * * *

Londoners are notoriously neglectful of their river; crowds of them may be seen along the Embankment any fine day gazing with interest at its sparkling or muddy waters—but as for using it as a means of transport, that is left to P.L.A. tugs, brick-barges, and an occasional pleasure-steamer. This month the Thames has received the somewhat hollow honour of having one of its reaches

—that between Westminster Bridge and London Bridge—named the King's Reach, in commemoration of the Silver Jubilee of King George V, and a suitable monument has just been unveiled in record of this fact. And the river has returned the gift with interest. During recent dredging operations (considerably above London, it is true), important finds of ancient weapons have been made, ranging from a Neolithic flint axe (c. 2000 B.C.) to single-edged and double-edged swords of the 9th or 10th century A.D. A fine Celtic sword and scabbard, of about 200 years before the first Roman invasion, were found near Oxford, and an interesting discovery was a spearhead of the Middle Bronze Age (c. 1100 B.C.). This last epoch has long been believed to have been an era of peace and prosperity, so it will be interesting to hear whether the spearhead belonged to a hunting weapon or to an arm of offence.

* * * *

Dominion zoos keep well up with that of London. Lord Moyne's collections from Melanesia recently domiciled in the Regent's Park Gardens were an acquisition of the first importance, and now we hear (from the Port Moresby correspondent of the *Pacific Islands Monthly*) that a collection of pythons, lizards, and tree-kangaroos has left New Guinea for the Toronga Park Zoo, New South Wales. They were collected by the Rev. O. G. Parry, of Lawes College, Fife Bay, Papua. The same correspondent tells of the discovery of Spanish coins on a mining claim at Wau, in the interior of New Guinea, which raises an old problem once again. The island coasts were visited by Saavedra in 1528-9 and by Grijalva in 1536, as well as by later expeditions of the *conquistadores*; and it is possible that some enterprising young adventurers wandered inland in search of gold—for was not this the *Is'a de Oro*? Another theory is that the coins are a relic of some money given to the natives by Dumont d'Urville, who visited the Louisiades during his last voyage round the world.

* * * *

During August the Science Museum, South Kensington, is staging an exhibition of model British Fishing Boats. Records have been taken of fast-disappearing local craft, and the display will have a romantic as well as a historical appeal.



General view of Niebla, with the Rio Tinto in the foreground

Archæological Research in Southern Spain.

By Mildred La Trobe-Bateman.

Hon. Associate of the Anglo-Spanish-American School of Archæology and Prehistory.

This graphic account of the excavation so far undertaken at the famous old city of Niebla, in the south of Spain, shows that so far the surface has been little more than scratched, and much more precious information awaits future excavators.

The work of Mrs. Bernard Whishaw is a household word among Spanish scholars.

SOME fifty miles from Seville the traveller on the Roman road from that city to Huelva crosses a great Roman bridge over the Rio Tinto. The scene is unique; the river flowing under the bridge is coloured blood-red owing to the copper solution in the water, and other metalliferous deposits. Crowning the steep slope of its further bank are the massive red walls and many sentinel towers of Niebla. Growing out of the red soil above the river banks are eucalyptus trees; their grey-blue boles reflected in the red and (in places) inky water flowing between ochre-tinted rocks add to the impressive colour scheme of the landscape.

For the last twenty years the Anglo-Spanish-American School of Archæology and Prehistory under the direction of Mrs. Bernard Whishaw has been doing research work in the town and its neighbourhood with remarkable results; in a short article the possibilities that are being opened up by this research can only be touched on.

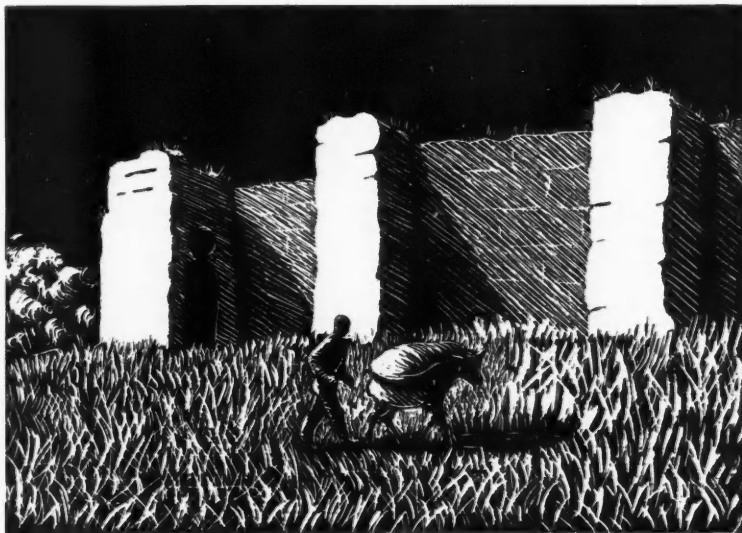
The origin of Niebla, the *Ilipula* of the Iberians, is lost in the mists of antiquity, though these are being dispersed here and there by discoveries pointing to Palæolithic times, including (probably) the *hormigón* used in the foundations of the castle and many artifacts of the Old Stone Age. The ancient name of the river, "Ibai-Oria" (reddish-yellow), is believed to have given the name to Iberia itself.

It is to its position on this historic river that Niebla owes its age-long history. At this point in its course

the Rio Tinto becomes navigable. Irrefutable evidence, based on research work at Niebla and at the Rio Tinto Copper Mines, shows that the fame of the copper ore

near its source in the Sierra Morena became known to the races of late Neolithic times.

When the Cretans arrived in search of the copper they found the Iberian town with its surrounding walls, and a civilisation which included an alphabetic script almost identical with their own, and (an important fact for the consideration of



The massive red walls and sentinel towers of Niebla

present-day archæologists) with that of the great prehistoric civilisation of which traces are now being discovered beneath the sands of the Sahara. Over 100 samples of this script are to be seen in the museum attached to the Archæological School, some of which have been translated by the late Dr. Jules Brouta, Doctor of Ethnology of the University of Louvain.

One of the most thrilling discoveries at Niebla is a great Neolithic harbour, 600 yards long by 40 to 50 wide, and nowhere less than 16 feet deep, even after thousands of years of exposure to the silt brought down by mountain floods. Its whole length is faced on the river side with wedge-shaped blocks of stone worked with stone artifacts, built in a ramp with pointed ends turned inwards. Thus the rush of the flood-water, instead of undermining the wall, drives the wedges more solidly into the soil behind them, so rendering the structure continually more secure. A canal built on

the same system and of the same date in connection with the harbour is still in existence. This harbour is still known by its ancient name: the Place of Embarkation (*Desembarcadero*), where the copper, brought down by beasts of burden from the mines, was loaded into barges to be conveyed out to sea. It is situated on the right bank of the river, where a sharp incline is crowned by the walls of the city, which here include a gateway approached by a broad stairway from the wharves.

In connection with the Cretan exploitation of the mines, the earliest prehistoric slag found in them shows that at least 20,000,000 tons of copper were produced and founded during that period.¹ The enormous hills of slag left are so well worked that hardly a grain of metal remains in them. But the slag of the second prehistoric period, attributable to later Greek colonisation, was so carelessly worked that the Romans found it worthwhile to re-found large quantities of it for the unextracted ore.

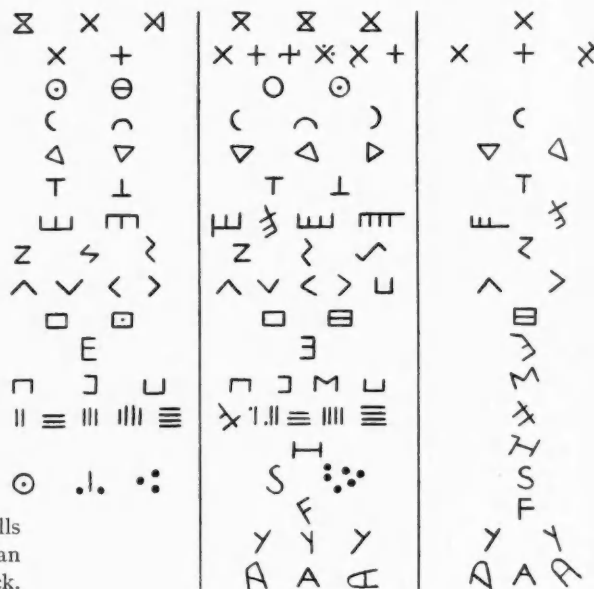
To return to the town itself. Its imperishable walls were founded in Neolithic times and were no less than 23 feet thick.



The Pre-Hellenic renovation of this tower shows the rough stones merely inserted into the "beaten earth," whereas the Roman additions are built in.

Their foundations lie immediately on the level of a layer of Neolithic potsherds and artifacts. Long after Cretan times, Niebla and the Rio Tinto Mines were once more colonised from Greece. Architectural remains, tradition, and folk memory show that about 1200-1100 B.C. Southern Spain received a considerable colony of the Heraclidæ when they were exiled from Peloponnesus during that

century. These pre-Hellenic people naturally availed themselves of the Neolithic architectural and hydraulic



COMPARISON OF EARLY ALPHABETIC SIGNS
In the centre column are signs found in inscriptions at Niebla, which remained in use in Andalusia down to the Arab period. On the left, signs found in excavations in the Libyan desert, still employed by the Tuareg, who claim descent from the ancient Libyans. The signs in the right column were discovered in Crete and at Mycenæ.

works, but instead of rebuilding such portions of the city walls as had fallen into ruin during centuries of neglect, they adopted the more economical method of cutting them away to a uniform thickness of 7½ ft., leaving, however, at intervals of about 100 ft., a projection consisting of the full thickness of the original wall, 23 ft. deep by 16½ ft. wide, to serve as sentinel towers—forty in number. Some of these towers needed strengthening or fresh masonry to produce their square outlines. This pre-Hellenic renovation was roughly done, the stones being inserted, not built into the original *hormigón* of the walls, which is "the earth beaten between boards," referred to by Cæsar in his *Commentaries*, when he said, "it was so hard that neither the hand of man nor the forces of nature could destroy the Iberian fortresses made of it."

Centuries later, the Romans, in their turn, reinforced much of the *hormigón* of the sentinel towers and of the walls of the castle, after the terrible destruction caused by the Carthaginians, when they besieged and

¹In case this estimate should seem staggering, it is of interest to note that in one year alone (1912) the British mining company shipped 1,744,024 tons of mineral, and again in 1919, 1,814,118 tons.

ally availed
d hydraulic

X
+ X

C
Δ

T
X

Z
>

Θ

M

X
Y

S
F

Y
A

TIC SIGNS
scriptions at
down to the
ations in the
, who claim
in the right
Mycenæ.

tions of the
centuries of
method of
of 7½ ft.,
ft., a pro-
the original
as sentinel
wers needed
their square
was roughly
lt into the
a is "the
red to by
d, "it was
n nor the
n fortresses

a, reinforced
s and of the
ction caused
sieged and

conquered Niebla about 500 B.C. This Roman work is unmistakable, for their stones are cut and fitted together so perfectly that they have kept in position throughout the ages without so much as a grain of mortar to secure them.

The five original gates of the city have their gateways placed so as to involve an inconvenient zigzag entry, to obviate which later masters of the city blasted holes in the walls or towers in more convenient positions. Several of the gateways show Arabic as well as Roman additions.

The Castle, which has been the centre of Niebla's life from earliest times, includes within and immediately outside its walls the remains of every culture already mentioned.

It was greatly beautified under the Greek dominion in the 4th and 5th centuries B.C., for even now the bases of no fewer than 28 Ionic columns are to be seen round the Atrium of the Inner Ward. These lay more or less buried in the debris of fallen walls and galleries until late in the 19th century, when the Town Council sold or gave them



Mycenæan capitals found in the Castle of Niebla.

away. Only one was rescued by Mrs. Whishaw, and is now in the Museum. Last autumn a large building in the Mycenaean style was discovered against the Castle walls, of which chambers have been excavated.



The Water Gate showing the entrance so placed as to necessitate a right-angle turn.

Niebla itself.

In the common phrase "seeing is believing," may I, as a late visitor to the Archaeological School, suggest the amazing interest of a stay there, short or long, on most moderate terms? If time prevents this, a day's outing to Niebla by motor-bus, 1½ hours from Seville or 45 minutes from Huelva, with a warm welcome at the School, should not be missed.

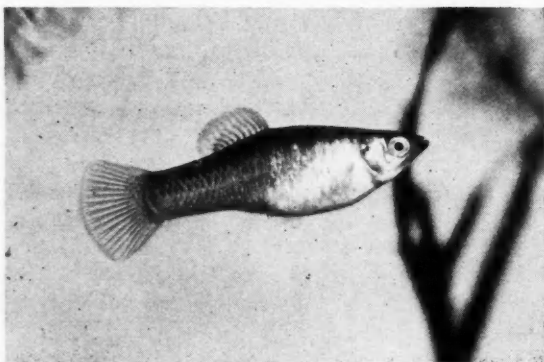
Serious students are able to do research work with permission from Mrs. Whishaw. The wages for a trained excavator amount to only four pesetas a day. For many years Mrs. Whishaw has enjoyed authorisation from the Spanish Government to carry on archaeological research, without which no one, native or foreign, may make excavations in Spain. With this authorisation and certain rights of possession, she is able to pass on this permission. This opens a unique opportunity, for any individual or body interested in such work, to engage in it at a minimum of expense and with great prospects of far-reaching results.

For all details of real archaeological value the writer is indebted to notes by Mrs. Bernard Whishaw.

On the request of the author, we have pleasure in stating that the illustrations to *Butterfly Immunity in Malaya* (DISCOVERY, July, 1936) were photographed by Mrs. L. Richmond Wheeler.

An All-Female Species ?

Very strange fish are the "Mollies" (*Mollienisia formosa*), which are found along the coast of north-east Mexico and the southern tip of Texas. Some two thousand specimens were examined in these waters and *not one single male was found*. These fish were formerly thought to be a distinct species. They have almost every characteristic of a species and no satisfactory explanation as to the absence of the males could be found. Recent research by the University of Michigan Museums has elicited the fact that these fish are hybrids between species so distinct that they were long ago placed in different genera. It has also



Mollienisia has a life-history much stranger than her appearance.

been found that these hybrid females mate in different waters with the parent stock on either side, with a resulting progeny identical with themselves. This solves the problem as to parentage, but why the majority of these hybrids should be females has not yet been definitely ascertained.

For Mountain Holidays

The appearance of two new volumes, very different in scope and subject, will be welcomed by lovers of mountains. Mr. W. T. Palmer, whose knowledge of our Lake District is profound and peculiar, has produced a new and revised edition of *Odd Corners in English Lakeland* (Skeffington, 6s.), which is written with his customary insight and charm. In these days of ramblers and hikers, his notes of warning to potentially imprudent "Youth Hostellers" are of special import. The photographs by Abraham of Keswick are as delightful as ever. The other work is *A Short Guide to the Slovene Alps* (Kleinmayr & Bamberg, Ljubljana, 2s. 6d.) by Mrs. F. S. Copeland and Mrs. M. Debelak, which is a brief and clearly-worded booklet of instructions for visitors to the little-known mountains of Northern Yugoslavia. Mrs. Copeland is well known to readers of DISCOVERY for her explorations in this region and her information can be trusted. We are glad to learn that when a new edition of this guide appears it is to be provided with maps; at present readers are referred to those of the Slovene Alpine Society.

A Better Basis for Reckoning

WE reviewed in the April number (p. 124) a book on the teaching of arithmetic which seemed to have special qualities for the stimulation of the mind of the taught. Since then another small work* has come to hand which shares these qualities in an equal degree, though by a different manner of approach. Mr. Emerson Andrews, an American writer, has revived and presented in an irresistibly attractive and persuasive form the old arguments for changing the basis of our numerical system from ten to twelve. He does not pretend, of course, to any originality in the fundamental conception, but he may, we think, claim a large share of that originality which consists in making an old idea one's own and working it out into all its conclusions with a fertility of invention and insight.

A Vote for Duodecimals

In this book of only 150 pages Mr. Andrews shows how, historically, men came to adopt the ten basis for arithmetic merely from the accident that they possess ten fingers on which, naturally, they began to count. He compares all the other possible bases and concludes unhesitatingly in favour of twelve. He suggests what he thinks would be the most acceptable symbols for the two new numbers—ten and eleven—which would be needed for the corresponding series based on twelve, and then gives an overwhelming list of the advantages of twelve over ten for the purpose. They arise mainly from the four factors which twelve possesses as compared with the two owned by ten. He carries out the argument into logarithms on the new basis, and into the enormous economy gained by the duodecimal compared with the decimal system of fractions. He adds—and this gives the teacher his opening—a series of suggested exercises in converting numbers in one system into another and demonstrates that everything which we can do on the basis of ten could be better done on the basis of twelve. The book winds up with a reprint of Herbert Spencer's dialogue tending in the same direction. It is, of course, well known that Spencer left injunctions in his will that if ever there were a serious attempt to induce the English to change their system of weights and measures into a decimal one, his arguments on the other side should be reprinted and distributed. Whether there is any good chance of men as a whole moving in the direction of reason as advocated in this book, is a matter on which every one will have his own opinion. Mr. Andrews is quite hopeful, and it is most refreshing to hear what he has to say.

F. S. MARVIN.

**New Numbers*. By F. EMERSON ANDREWS. (Faber and Faber, 6s.)

oning

a book on the
have special
of the taught.
to hand which
though by a
son Andrews,
esented in an
orm the old
ur numerical
ot pretend, of
al conception,
share of that
old idea one's
usions with a

Mr. Andrews
the ten basis
at that they
they began to
le bases and
twelve. He
st acceptable
and eleven—
onding series
whelming list
the purpose.
which twelve
by ten. He
on the new
ained by the
stem of frac-
his opening—
g numbers in
s that every-
ten could be
book winds
ogue tending
I known that
er there were
change their
imal one, his
eprinted and
ance of men
as advocated
one will have
hopeful, and
say.

MR. MARVIN.

(Faber and

Progress in Aerial Photography.

By Charles H. Gale.

Fairchild Aviation Corps, New York

The new nine-lens aerial camera—the world's largest single unit aerial mapping camera—incorporates many innovations in the field of aerial photography, including the use of eight steel mirrors to reflect the images to the side lenses: it weighs 305 lbs., stands more than 3 ft. high and takes all exposures on a single sheet of film.

THE world's largest single unit multi-lens aerial mapping camera has recently been completed for the Coast and Geodetic Survey of the U.S. Department of Commerce by the Fairchild Aerial Camera Corporation. This unique camera, designed by Lieut. O. S. Reading, of the Survey, is intended for mapping from a higher altitude than has ever before been practical with multi-lens equipment. It has nine vertically mounted F4.0 lenses, eight of which have associated steel mirrors of high reflectivity, weighs 305 pounds when loaded, stands 38 inches high, has a maximum diagonal cross-section of 35 inches, and has one large film for all lenses instead of a small individual film for each lens. The weight of the camera and accessories needed for a photographic flight totals 636 pounds.

The nine-lens type of mapping camera has a number of outstanding features:—

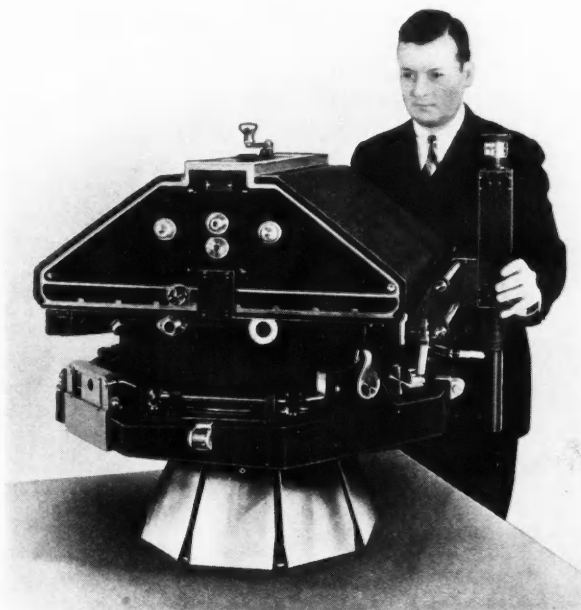
It is fully automatic and can be loaded in daylight; after the camera is in operation, the photographer has merely to keep the camera level by means of two spirit levels; it will cost 25 per cent. less than present equipment to operate; the need for adjusting radial line plots, a highly expert and time-consuming laboratory procedure, by which photographs are assembled into mosaics in accordance with ground control points, will be largely eliminated; and it has $4\frac{1}{2}$ times the stereoscopic parallax of the single-lens and five-lens cameras, making it practical to extend the advantages of stereoscopic mapping (securing contour

maps from aerial photographs) to more level terrain than is possible with present equipment as well as considerably reducing the cost of topographic mapping. From a working altitude of 30,000 feet above sea-level the camera can cover about 600 square miles at one simultaneous exposure of all nine lenses. (Due to its longer focal length the 9-lens camera photographs slightly less than the 10-lens, but secures greater detail.)

The camera has another advantage in that by virtue of its single film for all nine lenses there is but one transforming process instead of four, as for the five-lens camera, or eight, as for the ten-lens. This results in considerable saving of time as well as material, and simplifies the achievement of precision. Because of its long focal length ($81\frac{1}{2}$ " instead of the 6" of the five-lens design) it provides the advantages of multi-lens equipment for mapping

from altitudes which hitherto have been practical only for single lens cameras. All the lenses are mounted vertically.

The camera consists of three main sections. On top is the film magazine and associated operating mechanism. The top of the magazine resembles a low-pitched roof. Below that is the chamber in which are located the nine vertical lenses and underneath that are the eight astronomical-type stainless steel mirrors, one for each of the wing lenses. These mirrors, mounted at an angle to increase the coverage of the wing lenses, give the camera an unusual appearance. The eight mirrors are

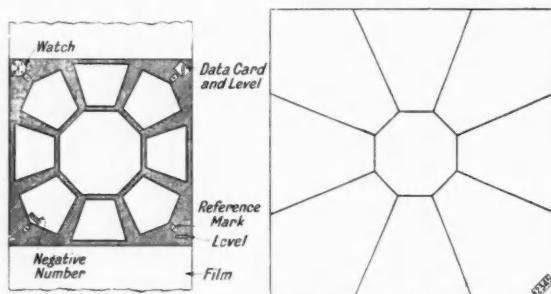


Mr. Sherman M. Fairchild with his new giant nine-lens aerial camera. On the right is seen the Telescopic viewfinder. Below is the octagonal chamber containing the mirrors, each for one of the eight wing lenses.

one of the chief distinguishing features of the nine-lens camera. Each mirror is $9\frac{1}{2}$ " long, 5" wide, and $\frac{1}{8}$ " thick. They are supported on a frame of alloy steel, slanting outward at an angle of 19° from the vertical and set at 45° to each other, forming an octagonal cone wider at the bottom than at the top. They are coated with evaporated aluminium to raise the factor of reflectivity from 60 to 80 per cent.

Each of the shutters for the nine lenses is actuated by an individual electric motor instead of by mechanical or electrical release mechanism; all nine motors operate synchronously, assuring simultaneous operation of the shutters. The negative size is 23" square. Each composite print made from this negative is 35" square. The areas covered by continuous exposures overlap each other slightly, but this overlap is automatically taken out when the negative is put through the special transforming printer in the laboratory.

Even the operation of the camera is new. Like all mapping cameras it is installed in the aircraft on a mount which holds the instrument in vertical position for "shooting" through an aperture in the floor. For actual photography the camera is lowered on its mount by means of special block and tackle installation fixed to the cabin roof, so that the mirrors extend 8" below the bottom of the fuselage, to permit unobstructed exposure. The camera is raised during take-offs and landings, to avoid any hazard from flying particles and from contact with the ground. For protection while in the extended position a metal shield is installed on the bottom of the fuselage about 4' in front of the mirrors.



Diagrams of the exposed negative (left) and the composite print secured with the nine-lens camera. The reference number of the negative is reproduced on the print. The special printer prints the octagonal centre section in the original size, while the eight wing sections are slightly enlarged so as to form a square.

This eliminates the direct blast of the slipstream, which might turn the camera about its axis and cause some unsteadiness, as well as drive damaging particles against the mirrors. It is loaded into position on the

plane with a worm-gear winch and pulley system and is transported to and from the plane in a specially constructed four-wheel cart.

To ensure the high precision essential to an aerial camera, specially treated and seasoned aluminium alloys and steel have been used for the construction; ball bearings have been fitted into practically all moving parts. The design and the materials used assure efficient operation under all temperatures at which a photographic plane can be flown.

The film, which is 23 inches wide and 200 feet long, sufficient for 100 exposures, is mounted in a supply spool on the top part of the camera. It is carried around guide spools and across the focal plane to the take-up spool in practically the same way as film is controlled in an ordinary hand camera. Behind the focal plane is a vacuum pressure plate which operates at the instant of exposure to hold the entire surface of 576 square inches flat and exactly in the focal plane.

Automatic Film-Winding.

In the film chamber also is the electrical drive mechanism by which fresh film is automatically wound into place in less than 15 seconds after the exposure has been made. The film may be wound manually, if so desired. A new roll of film may be installed in the camera in daylight while in flight in less than 5 minutes.

In the chamber supporting the lenses are four auxiliary lenses which automatically record on the film reference marks used in checking for possible shrinkage of the film between exposure and preparation in the laboratory. By means of these measurements proper compensation may be made to secure high precision in the completed print. These lenses automatically record on the film, also, a watch, showing the time of exposure, two spirit levels, the number of the picture, and a card with identification information. A punch automatically perforates the edge of the film after each exposure so that the laboratory staff, working in the dark, can accurately cut the film into sheets, in which form they can be handled with minimum strain and distortion. Developing and drying film in reels would introduce minute distortions sufficient to create discrepancies in mapping.

An extremely important element of the Fairchild 9-lens camera is the automatic telescopic sight attached to the side. It is $2\frac{1}{2}$ " square and 20" long. Through it the photographer can see the area being photographed. The sight includes hair lines, which form a grid and enable the operator to detect the degree the giant camera must be turned on its mount to compensate for the plane's drift, so that each exposure will be made with two sides of the film parallel with the line of flight.

A moving wire, which can be regulated for any overlap from 10 to 75 per cent., moves across the grid and automatically operates the shutter switch.

A special printer is required to secure precision positives from the film. It has a central lens, but only one lens for transforming the wing negatives. The film is mounted in a frame, which is rotated so as to bring each of the oblique pictures into proper position for printing. The sensitised paper on which the prints are made is rotated in conjunction with the film frame. The final print presents a true perspective on a single plane.

Comparison of the nine-lens camera with the five-lens and ten-lens designs indicates the main characteristics of the new giant device. The nine-lens instrument is a single unit; the ten-lens camera is composed of two five-lens cameras on a common mount with co-ordinated shutter mechanism. In the nine-lens camera the images are exposed on a single sheet of film instead of on individual films which must be matched together in the laboratory. The nine-lens camera can be used for the precision mapping work at extremely high altitudes. The ten-lens camera is utilised principally to minimise the amount of ground control necessary for an aerial survey and for mapping projects from a lower altitude.

Comparison between the Fairchild nine-lens and five-lens aerial cameras, both of which are used for mapping, indicates the general performance of the former. For instance, to secure vertical aerial photographs of the same scale for mapping purposes the nine-lens camera may be flown at the smoother altitude of 13,750 feet while the five-lens would have to be flown at 10,000 feet. Comparative results would be:—

	Five-Lens	Nine-Lens
Width of Strip	10.15 miles	11.05 miles
No. pictures needed per strip . .	432	68
Total No. exposures needed to cover given area	7,350	1,020

(continued from next column)

city and for seven days circumambulated the walls, roaring. Then the gates were opened, it rushed in, burst, scattered poison all round—and that was the end of the city.

The film, taken by Dr. Wales and Mrs. Wales, was eloquent of the difficulties which had to be overcome. The party set out from Lopburi in lorries, which soon became bogged; then began a five-day trek in ox-carts. At one point a river had to be crossed. The baggage was transported on an improvised bamboo bridge, the oxen swam, and the carts were drawn through the water.

An article by Dr. Wales on the expedition is promised and will appear in a later issue of DISCOVERY.

Exploration of Sri Deva.

Discoveries of great importance to archaeologists and anthropologists were made by Dr. H. G. Quaritch Wales on his recent expedition to the ruined city of Sri Deva (pronounced *Shree Tep*), in Siam. Recently, Dr. Wales delighted a meeting, at the Royal Society, of members of the Royal Asiatic Society, the Indian Society, and the School of Oriental Studies, with a description of his finds, illustrated with lantern slides and with a short film depicting the journey to the city.

The city of Sri Deva dates from the 5th century, and has never before been visited by a European. It is believed to have been founded by emigrants from the North Deccan. The site is some two miles in length by one mile wide, and comprises a main city and a subsidiary city, the whole surrounded by a moat. The main city contained a lake, two tanks, and a number of towers built about the road, which ran straight through the middle. The towers represented the most ancient Hindu buildings in Indo-China. Each had an entrance porch facing west, and false porches on the other sides.

A find of great interest was a large mass of schist, bearing two lines in Sanscrit. This, like the towers, dated from the beginning of the 6th century. Several statues of four-armed Vishnu were discovered, in a fair state of preservation, and also stone giants, which Dr. Wales thought guarded the gates. About 600 A.D., for some reason not ascertainable, the city was abandoned to the jungle, and remained so until six centuries after, when the Khmers reached it and reoccupied it. The old images were thrown out and new towers were built. These were not, however, of equal workmanship to the earlier ones, and Dr. Wales showed that, in cases where Khmer sills had been fitted to the old towers, the former had fallen away, leaving the pre-Khmer structure in its original state.

Dr. Wales related an amusing local legend which accounted for the abandonment of the city. There were two hermits, who dwelt by two wells. To one of them the King's son came as a pupil. One day the hermit told him of the peculiar properties of the two wells. If he were dipped in one, he would die; water from the other would restore life. The hermit agreed to give a demonstration, but when he was dead, his pupil, instead of administering water from the other well, ran away. When the other hermit returned, he saw that the water of the well in which lay the hermit's body was boiling. He quickly restored him to life with water from the other well, and the hermit laid a great curse on the city. He fashioned the image of a bull, filled it with poison, and gave it life. It went to the

(continued in previous column)

About Chameleons.

By F. P. G. de Smidt, M.R.C.S., L.R.C.P., D.P.H.

Medical Research Laboratories, Kenya

Dr. de Smidt, in the course of nine years or more in the Nairobi district of Kenya, has had an unequalled opportunity of studying in his leisure hours the three characteristic local species of chameleon. His detailed and amusing account of their habits is not only interesting in itself, but will remove many misconceptions, popular and otherwise. The photograph was kindly presented to the author by Dr. Van Someren, the well known entomologist and ornithologist, curator of the Coryndon Memorial Museum, Nairobi.

THE Chameleon almost rivals the snake as a source of popular misconception. In *The Two Gentlemen of Verona* the servant Speed remarks, "Though the chameleon Love can feed on the air, I am one that am nourished by my victuals, and would fain have meat"; which suggests that in Shakespeare's time a statement that chameleons lived "on the air" would have been regarded as platitudinous. This notion perhaps arose from the reptile's habit, when alarmed or annoyed, of making himself "frightful" by puffing himself out by means of the saccular extensions of his capacious lungs. Also, perhaps, from the fact that he does not usually go about actively in search of food, like his lizard cousin on the ground or sunny wall, but sits serenely motionless on his twig for hours, waiting for his food to come to him. Then, when he feeds, he does it in a manner so instantaneous that the casual watcher is likely to miss the fun.

Though his legs do not suggest that he is "nourished by his victuals," chameleon is certainly one that "would fain have meat." And his method of getting "meat" introduces us to another injustice to him—killing with faint praise his fine long-range marksmanship with his astonishing tongue. In his great book *The Land of the Lion* Cherry Kearton, that delightful and highly accurate portrayer of Nature's creatures, gives an excellent photograph of Hoehnelt's chameleon, common in the Kenya Highlands, but unfortunately includes in an otherwise good account of him the statement that he has "a tongue that is nearly as long as his body." One feels sure that Mr. Kearton really meant to write the word "twice" instead of "nearly"; but even that would, I believe, have been short of the mark. In Parker and Haswell's well-known *Text-Book of Zoology* there appears the more encouraging statement that the chameleon's tongue "is so extensible that it is capable of being darted out to a distance sometimes equalling, or even exceeding, the length of the trunk; this protrusion can be effected with lightning-like rapidity."

But when one takes the trouble to keep chameleons captive under approximately natural conditions in a vivarium, or on garden shrubs, where they can be

watched at leisure from an easy-chair; and, as is easily done, to tame them into taking insects from the fingers, or, while perched on the hand, to catch flies on window-pane or wall, one realises how sadly chameleon's qualities as a potential public entertainer have been depreciated.

Death of a Fly

To watch chameleon taking his meals, on a warm day when his vitality is full, is a rare entertainment. Catching flies off a wall, or, more productively, off my patient dog's nose, and putting them one after the other into the vivarium, keeps chameleon on the constant alert. Actually, though, he is always on the alert, although he might not appear to be. Some of the insects he will take at ordinary range of his tongue—a little more or less than the length of his body; at more elusive flies he will easily make shots at a distance which seems incredible; and he will only fail to bag his "game" when this happens to move on at the instant his "shot" is "fired." The projecting, hemispherical, skin-covered eyes, with central pin's-head aperture through which the bright pupil shines, are rotating actively in their jerky way, each eye working independently of the other, one looking forward or upward, the other backward or downward, so as quickly to embrace all points of view. A fat fly enters the wide field of vision behind: chameleon rapidly turns, fixes the doomed insect now with both eyes together, and straining forward as far as he can—he does not believe in taking chances—follows the progress of the fly until it pauses; then a flash of an astonishing length of tongue with bulbous, adhesive end; and the fly is next seen head first—almost invariably head first—between chameleon's big jaws which have closed upon its thorax and so killed it instantly before it is masticated into a shapeless pulp and swallowed. Let us say the above refers to our Horned Chameleon, *C. Jacksoni*—excellently represented in one of his many poses by the photograph from life. The hornless species, *C. Hoehnelti* and *C. dilepis*, which the writer has observed, after catching a large fly nearly always hold it gripped and dead between the jaws for minutes before chewing and swallowing it:

as though to savour the pleasure of the capture, or, more probably, the insect's juices trickling into the mouth.

The tongue-shooting is done with consummate ease and precision, in a delightfully effortless way, however long the range. Chameleon is a very canny sportsman: he does not waste his "ammunition" on game which he feels to be out of his long range or moving too fast for a sure shot. At least, not normally; but I have thought I have seen a very hungry chameleon misbehaving himself—or herself—on rare occasions in this manner; though it was difficult for me to judge fairly. Normally, then, he will not be seen to take a "pot shot" on the chance of making it a fatal one. Certain human sportsmen, kindly imitate.

In regard to the greater length of shooting range, one can estimate this by taking some attractive insect between the fingers, and offering it to a tame chameleon perched on a branch. He stalks quickly out along the branch, swaying his lithe body backwards and forwards between each step—the picture of menacing stealth; but still observing the surrounding landscape in an apparently casual way, in the hope that something more succulent than that which he is going for may turn up within range on his way. Then, arriving at the branch tip, he clings to this with his hind feet—which are actually peculiar bifid hands like his front hands, and throwing a loop of prehensile tail round the twig behind him, he strains forward to his utmost—while I unobtrusively withdraw the insect to a greater distance—and now fixing both eyes upon his target, with characteristic easy self-confidence brings off one of his special "stunts" of marksmanship.

Sensational Shooting

On a warm day, when the reptile's vitality is at its height, the tongue flashes out and back so rapidly that the eye cannot follow it. In cold weather, the tongue flops out slowly enough for the whole process to be easily seen. But, whether cold or warm, the accuracy of the "shooting" is of the "highest possible" class. The length of the chameleon's tail is about equal to that of his trunk. My highest estimates of the range of his tongue-shooting are about the length of the body *plus* tail multiplied by one and a half—that is, of course, about thrice the length of the body. I do not think this to be an over-estimate. With chameleons at ease in the vivarium or on garden woody shrubs observed at my leisure from a chair, I have often been astonished by the most sensational tongue-shooting which appeared to be certainly twice the length of body *plus* tail. But eye-judgment is difficult, and self-delusion is easy. The question could no doubt

be settled by repeated accurate measurements by cinematographic methods. It is certainly, I think, worth doing.

Colour Changes

Colour-changing is the capacity for which chameleon has become proverbial; and it is generally absurdly misrepresented; for although he is a very good "quick-change artist," yet his actual colour-changes are far less sensational from the popular point of view, than they are interesting to the biologist. Actually, the most rapid and striking colour-changes occur in response to the reptile's emotions—fear, anger, and other excitement. Speedy and very pronounced changes in hue are effected also by marked changes in the temperature of the air about him.

For brief examples, the species *Chameleon dilepis*, normally bright green in its natural leafy surroundings, will, when frightened and angered by being taken too roughly in the hand, flash out rapidly into cheetah-like circular black spots. If this species is transferred into a vivarium containing only dry grass and brown twigs, his colour changes gradually to a khaki-brown tint. But the change is far from rapid—it is, I believe, the result of a thorough, subconscious kind of study of environment by the reptile's eyes. But, except for the beautiful orange stripes which appear in the skin of the throat when he angrily puffs this out, this chameleon, as far as I am aware, can, no more than the two other species dealt with here, assume any colours but more or less variegated shades of green and brown. Similarly, the horned chameleon (*C. jacksoni*) is usually of more or less variegated shades of green, and grey, and russet brown, when found in his home among the shrubs and smaller trees; though the sexes differ to a considerable extent in their "colour schemes." When annoyed, he, like his cousins, puffs himself out, jerks his body grotesquely from side to side, and flushes out into reticulations of dark brown with a longitudinal row of dirty-white patches; and dark bands appear radiating from the pupil-aperture of the eye, giving it a resemblance to a child's striped ball.

Hoehnel's chameleon, common in the green and leafy Limuru and Kabete districts near Nairobi, is rather similar in its green and brown variations of hue. These have produced families of baby chameleons on my garden shrubs: charming little creatures, with that dainty grace and delicacy which touches one in the infants of all animals.

The baby Hoehnel's chameleon, now hornless as a new born calf, but with promise in tiny tubercles of those impressive horns to come—is of a bark-brown in colour, subject to variation brought about by excite-

ments and changes of temperature. As my examples grew older, they became a regular study in various sorts of brown. But it seems quite beyond their powers to turn green like their mature parents. It appeared that to be able to dress themselves in leafy green, they had to wait till the end of what my wife called their "school age"—that is, when they were about four or five inches long in the body. Associated with the strong tendency to "brown study" seemed to me to be a preference of these acrobatic infants for clambering sure-footedly about the larger but quite smooth surfaced trunks and branches of the woody shrubs, while their fathers and mothers perched comfortably on the smaller leafy twigs.

When Greek meets Greek

Chameleon does not like to meet his acquaintances, unless one should happen to be a—to him—attractive lady. Therefore, when Jacksoni met Dilepis on the same twig in their vivarium, each would arch his back in a cat-like fashion, puff himself out jerk himself in an absurd "staccato" manner from side to side. While the former would further show his annoyance by coming out into dark brown reticulations and whitish blotches, and the latter by blossoming into cheetah-spots.

In the cold of early morning, chameleon loves to bask his cold body in the genial rays. To do this, he flattens his body sideways till it is elliptical in form, and almost as thin and flattened as a thick leaf, curls his prehensile tail into a neat, flat spiral, puffs out all the loose skinny tissue under his chin, and leans over on his twig to the exact angle required for the sun's rays to strike perpendicularly on one of his sides. Now that side, turned to catch the pleasant heat, rapidly becomes of a very dark brown, almost black colour; while the opposite side, in the shadow, retains its normal green tint. Which seems obviously an appreciation of the physical fact that a dark-coloured surface absorbs heat. Conversely, when the chameleon is put into an ill-ventilated glass case, with the tropical afternoon sun blazing into it, he will very quickly change into his lightest-coloured "tropical wear"—a pale, whitish-buff colour. At the same time, he becomes extremely active, his jaws begin to gape widely, and apparently he hunts everywhere for shade. And if shade and reasonable coolth are not given to him, he will soon become a case of heat-stroke.

It must here be noted that reptiles, being "cold-blooded," depend very largely upon the sun's heat for their energy or vitality. In cold weather (and in the Kenya Highlands the thermometer in August often descends rapidly even to the thirties Fahrenheit between midnight and sunrise) they are always very sluggish;

to become energised into activity again as soon as the sun shines upon them. Yet even reptiles can get "sun-stroke"—more properly termed "heat-stroke." But in nature they very rarely do; because, unlike poor *Homo sapiens* in his various absurd costumes, reptiles are fortunate enough to be able to go naked in the tropic heat, and thus avoid various dangerous evils.

If a man is too heavily clothed on a hot day, he runs risk of heat-stroke, when he stands about in the sun out of the cool wind, whether he wears a *topi* or not. And this risk increases directly with the amount of moisture in the air. Hence the rarity of "sun-stroke" in the dry, windy uplands of Kenya—though the shadow of one's whole body may lie between one's feet.

When humans, or most of their mammalian cousins, have to go in the heat for more than a few hours without water, they begin to suffer agonies. But it seems that chameleons can go without any drink of water for many days, even weeks, on end. Yet, paradoxically enough, my chameleons would always drink greedily when water was offered to them. No doubt, however, when food is sufficiently plentiful, much of the water they need comes to them in the juicy bodies of their insect diet. And also, the licking of a leaf which is slightly damp with dew or rain-mist is to chameleon a quite pleasant and satisfying drink. But my notes given below were made during the severe and quite abnormal drought in Kenya of 1933. Insects are only at all numerous after sufficient rains.

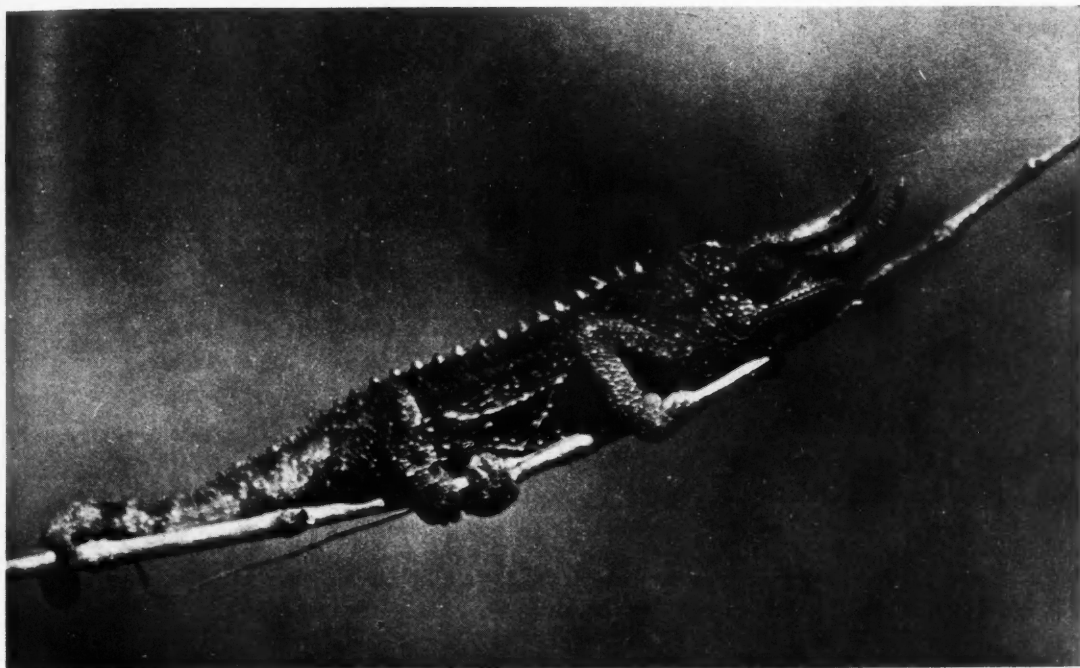
Chameleons in Drought

For several months, all through this drought, there were about seven Hoehnel's chameleons, imported from Limuru district, where it is always greener and cooler than Nairobi, on some shrubs in front of my windows and verandah. Most of the leaves dropped off, there came to be very few insects about, and I could never detect signs of dew upon what leaves were left. Although one chameleon died, in spite of, or perhaps helped by, my attempts at medical aid, the others kept perfectly well all through that trying period, and some female even produced an untimely family—soon disposed of by the garden shrieks. Never did I observe one of them to lick the surfaces of leaves in search of moisture, as they do during rain. In September, after months of this terrible dry weather, it occurred to me to imitate rain by tossing up a tumbler-full of water in the air, so that the drops fell upon the almost withered shrubs; then, to improve the technique, I similarly squirted water with a syringe. No sooner was this done, than the chameleons showed excitement, and began greedily to lick the wetted leaves and twigs, and to stalk and neatly catch depending drops with slightly pro-

s soon as the
iles can get
heat-stroke."
e, unlike poor
mes, reptiles
naked in the
gerous evils.
day, he runs
n the sun out
or not. And
t of moisture
oke" in the
e shadow of
et.

lian cousins,
ours without
t seems that
ter for many
ally enough,
when water
when food
r they need
insect diet.
y damp with
pleasant and
y were made
drought in
nerous after

ught, there
ported from
and cooler
ny windows
d off, there
could never
e left. Al-
or perhaps
others kept
g, and some
—soon dis-
I observe
n search of
mber, after
rred to me
of water in
st withered
I similarly
this done,
and began
d to stalk
ightly pro-



An adult male Horned Chameleon (C. Jacksoni)

[Photograph by Dr. Van Someren]

truded tongue. Yet, if I left them for an interval of a week or more between the providing of these gratuitous drinks, they seemed to be quite contented.

I used to believe that chameleons would only drink thus from drops and wetness on leaves and twigs. But, in the case at least of the three species I have observed, all would frequently descend to drink at the little artificial pond on the ground of the vivarium, even though water were regularly sprinkled on the leaves and twigs where they spent almost all their days. And when a chameleon drank thus at the ground drinking-pool, he would generally spend minutes over it, sucking in the water by slow in-and-out movements of the bulbous tongue-end between slightly parted jaws.

How much thinking does chameleon do? Perched sedately on his twig, motionless but for his twitching, ever watchful eyes, with his grimly humorous cast of countenance, he suggests a saturnine moralist thinking out a sermon. Actually, as I guess, he does at least as much thinking as the common Kenya African garden-boy—whom I have known to plant a cherished seedling upside down, and then thoughtfully water it.

Two straight branches of a shrub joined near the trunk at an angle of about 45 degrees. On the middle of the lower branch sat a chameleon—Hoehnel's species. On a twig sticking up from the end of the upper branch

there suddenly appeared the large green larva of a mantis—a favourite chameleon dainty. Spotting this, chameleon tried vainly by reaching up with his front hands to gain the upper branch—because the insect was far out of his range of tongue. Finding that attempt hopeless, chameleon hastened along his own branch—not towards the insect, but in the opposite direction toward the apex of the angle, until the upper branch came within his reach; then quickly hoisting himself up on to the upper branch, he hastened out again along it, and took a well deserved and satisfying luncheon. This is certainly the procedure that would have been adopted by a man under like circumstances; but to the man it would have been credited as "reasoning intelligence."

During a rain-storm, I once—and never again—saw a horned chameleon, which was clinging to a stout, vertical branch, down which rain trickled, apply his long nasal horn to the surface of the branch, so that the water by surface tension was diverted to stream down his horn into his mouth. I doubt if this is one of the prescribed purposes of the horns. I have only seen them used in chance tussles between males meeting on the same branch; laughable to a degree, and much like the clowns' bogus wrestling-match on the variety stage. But Dr. Van Someren described to me a sexual battle between two male horned chameleons, using their horns

like stags, and ending in a broken back for one of the combatants. My water-drinking incident may perhaps, though scarcely convincing, be an example of those extremely interesting little gleams of extemporaneous intelligence which one sees, or perhaps more often thinks one sees, in even the lowliest among animals.

Once during the warm, dry weather, I watched Hoehnel's chameleon descend meditatively the stout trunk of his shrub—a garden species of *Datura* with enormous white trumpet blossoms which we call "moon-flowers," but then sadly flowerless, almost leafless, from the drought. The trunk sprang from near the cement bath-waste channel, which was wet from some clean water I had run through the bath. But, reaching the ground, my chameleon did not go for the drain; he made straight for a dead leaf which lay near it, in the hollow of which lay a large, shining drop of water splashed from the bath-waste pipe. That drop the chameleon meditatively drank up; and then, meditatively, returned to climb slowly up the several feet of trunk to his accustomed place among the branches. Apart from the intelligence of this performance, it at least evidences long eye-sight.

Chameleon's usual intensely slow and deliberate movements are very characteristic of him. A certain African tribal legend to account for this phlegmatic deliberateness of his walking pace is that, in ages past, God for reasons inscrutable despatched a chameleon—the forefather of all his tribe—on a divine and very urgent errand. But patriarch Chameleon at the end of his journey found himself some days overdue; for which reason, he and all his seed were promptly punished by being deprived of all of what little capacity for speeding they had been endowed with. This is one of several variations of the legend I have heard. But actually chameleon's slow habit of progression is simply a canny piece of strategy; his speed is always nicely adjusted to his actual need.

Bedtime Manners.

The sleeping habits of chameleon are interesting and intelligent. Going to bed always punctually at 'sundowner' time, he retires night after night, month in and month out, to the same twig to roost, or to exactly the same part of a particular branch which he has selected as a good berth. There he slowly lies down, gripping fast with front and hind hands, coils his tail into a flat spiral, shuts his restless eyes at last, and, turning a little pale, sleeps imperturbably until sun-rise which in this latitude occurs at about 6.0 a.m. all the year round. At sun-rise, when the air is always at this high altitude rather chilly, his "getting up" is as leisurely as his going to bed.

Some years ago, two of my horned chameleons chose to sleep on the upper end of the same thin branch, where one would roost an inch below the other; so that at bed-time there was often a funny tussle between these two. If the fellow who had chosen the lower "bunk" happened to arrive first, the later arrival had to climb over him to get to his bunk, and this circumstance gave rise to a sleepy sort of wrestling match, "lower bunk" objecting forcibly, and "upper bunk" no less disagreeable about it. The indiscreet affair was generally settled by "upper bunk" swinging round head downward beneath the other on the branch and so gaining his objective.

It seems that chameleon knows his sleeping place by its form and whereabouts, as a man knows his own bedroom. To test this, I once removed the branches surrounding a chameleon's sleeping-twig, and, while leaving that untouched, put several new branches round about it instead. But that same evening the chameleon—he was only a half-grown Jackson's chameleon—showed no signs of puzzlement: he proceeded calmly to his accustomed sleeping-berth, and, moreover, took nearly the shortest route to it.

Domestic Strife.

My Jackson's chameleons, husband and wife, are definitely not good friends, although they are not bad enemies. Most of the flies which I put into their house find a permanent abode in Mr. Jackson, who is more active than his lady. A large fly settled on the window of their home, and both, as usual, went for it eagerly. As usual, too, Mr. Jackson was in front, and he had already caught the fly when the wife beside him had only got as far as taking aim for her shot at it. Whereupon she lost her temper quite; shaking herself from side to side in the extremity of her anger, she turned towards him and gaped at him with widely opened jaws—the tongue projecting up from the floor of her mouth giving an absurd suggestion of wicked cursing. A few days later, this little domestic scene was repeated exactly, except for that in addition to the angry shaking and apparent "cursing," this time she went for her exasperating spouse and grasped him viciously by the root of his tail: then thought better of it, and retired in evident high dudgeon.

It is a general and regrettable fallacy to interpret animal behaviour in terms of the so highly specialised and sensitive human mind. But that human mind has evolved from the reptilian one, and its crude fundamentals are the same. And it seems impossible to misinterpret the above exhibition of chameleon manners.

Seed Dispersal of the Compositæ.

By H. E. Green.

The wonderful mechanisms, by which plants of the Composite order distribute their seeds, are comparatively well known, and in this article it is contended that the seed-dispersal methods, adapted to the surroundings in which each plant lives, have been developed by a process of Natural Selection; at all events there is little doubt as to their practical efficiency.

WHILE investigating questions regarding seed dispersal I have gradually formed the opinion that there is a greater relationship between structure and function than is generally supposed. With the general acceptance of the theory of Natural Selection there was, no doubt, too great a readiness to accept interpretations of the shape of structures or organs as being fitted to perform certain functions, because it was felt that nothing that was useless could be evolved: thus Kerner could say "each thorn, prickle, or hair has a definite function to fulfil." Many of the explanations put forward were probably quite wrong and it is hardly surprising that when many mistakes have been detected there should be a temptation to dismiss the whole idea as false, and thus we now find peculiar features described as "probably of no significance" or as "merely the result of the waste products of metabolism," but there seems a danger that such suggestions, unless based on very strong evidence, may tend to discourage investigation.

There is little doubt that variations arise constantly and, if Natural Selection is always acting, it is surely

minor variations tend to be important in the struggle. A suggestion of how small may be the controlling factors is seen when we note how a species will flourish in one situation and yet be crowded out of an adjacent area, though the differences of conditions are so slight that no explanation can be offered.

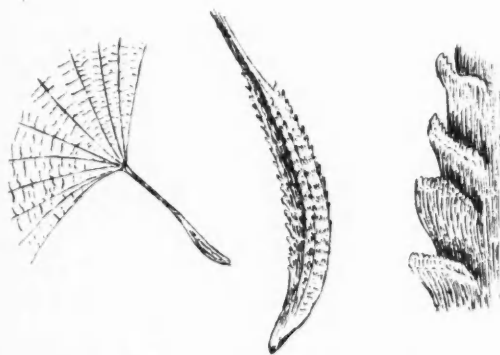
A few examples of species belonging to a single order—the Compositæ—will serve to show that there is evidence of a relationship between the peculiarities of structure and the requirements of habitat.

Mention of the Compositæ in connection with seed dispersal at once brings to mind the utilisation of the wind for such dispersal and the mechanism of the pappus, so efficient for that purpose.

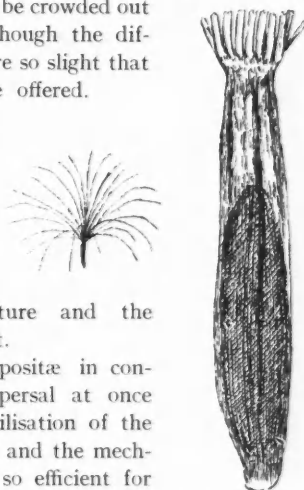
The familiar dandelion "clock" is an example of a type of pappus which is found also on the Goatsbeard (*Tragopogon*), Catsear (*Hypochaeris*), and Ox-tongue (*Picris*). In these cases the pappus is not carried directly on the fruit, but at the end of a long stalk or beak which arises from the top of the fruit. It takes a fairly strong wind to break the fruits loose from the head and with such a force the parachute will carry for a considerable distance. Even when it reaches the ground, however, progress is not necessarily at an end because if it has fallen on a smooth surface the shape is such that the next breath of wind will cause the pappus to lift and move forward, dragging the fruit, with its end resting on the ground, until it slips into a crevice, is caught on soft or sandy ground, or becomes entangled in herbage.

These plants often grow on sandy or gravelly ground and there the burial of the seed is of great importance. With so large a surface presented to

¹Not, as popularly regarded, a seed, because an envelope or capsule is present, though not obvious, as there is only a single seed in each. The word "fruit" is here employed for the less widely understood correct term "achene."



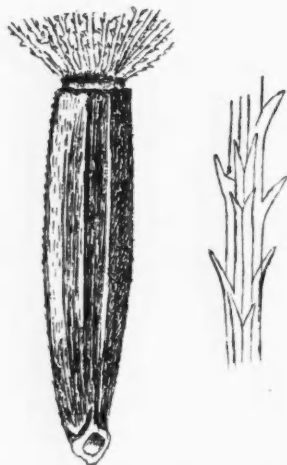
Goatsbeard (Tragopogon) : left, the fruit with pappus; centre, the fruit, enlarged; right, fruit scales, still further magnified.



Coltsfoot, showing the fruit natural size with silky pappus, and the fruit alone, enlarged.

reasonable to conclude that the pressure exerted will be so effective that even slight variations, if favourable, will be preserved, while unfavourable ones are eliminated. While general conditions are fairly stationary, competing species must be closely matched and quite

the wind it is clear that there is a considerable risk of the fruit being lifted out again after it had sunk into the ground but in the upper part of the fruits will be found points or scales directed upwards to prevent withdrawal, or even, on loose soil, to assist in burying the fruit. As the fruit becomes firmly held the wind will cause the beak to snap, releasing the pappus.



Fruit of Hawkweed (*Hieracium vulgatum*), enlarged, and pappus hair showing teeth.

A very different pappus is found on the fruit of the Coltsfoot. The hairs are soft and silky, and, instead of standing out firmly like an umbrella, they rise at different angles, spread widely, and curve outwards so that, when dry, the whole structure presents a more or less globular form. The head of fruit does not stand much, if at all, above the level of the adjoining vegetation and it matures early in the year when the air is generally moist. The fruit is small and very light, for the outer coat is loose and the actual seed within very tiny. Thus we have a structure which will be raised by a gentle breeze and, when on the ground, can be rolled along by the slightest breath of air until moisture is reached. In addition, as the soft silky pappus will adhere to any moist surface with which it comes in contact, it will often be transported by animals or birds over longer distances than are usually covered by wind-borne fruits. This is probably a very important

factor with all fruits with a soft pappus.

Hawkweeds (*Hieracium*), Golden-rod (*Solidago*) and Fleabane (*Erigeron*), have pappus which does not spread very widely, but has rather the form of a cone. The hairs are rather rigid and bear teeth directed upwards. This type I find usually associated with species



Fruit of a thistle (*Cnicus lanceolatus*), enlarged to show the pappus detached.

which grow amongst herbage where the cone shape allows the fruits to sink more readily than would a more widely spreading pappus. As the blades of grass sway in the wind they catch against the teeth on the hairs and gradually drive the fruit inwards while it is held by the upturned hairs which usually line the sides of the fruit itself. The pressure exerted by the spreading pappus tends also to lift the fruit, and I think it will be found that they are in many cases released singly by these means.

The fruits of Thistles (*Cnicus*) have a large silky and feathery pappus, but the action here is quite different. At the base of the pappus is a band of tissue which becomes detached, though it remains encircling a knob at the top more or less tightly and for a time holds the fruit. When shaken or knocked, as will happen when a bush or hedge is encountered, the fruit is released,

thus often reaching a type of ground, amongst dead leaves and sparse herbage, which appears peculiarly suitable. In this instance it is no disadvantage if the hairs from more than one fruit become entangled, for as one is shed its pappus merely helps



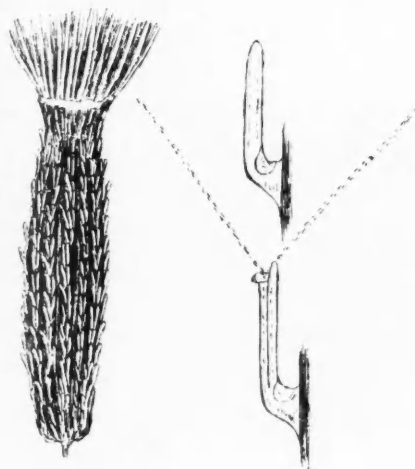
Bidens cernua (Bur-Marigold), showing the awned fruit, and the teeth on one of the awns (both enlarged).

to increase the buoyancy for the remainder.

The Wall Lettuce (*Lactuca muralis*) has a rather small silky pappus while the fruit itself is flat and the few on each head are so pressed together that at first sight it would appear that there was only one fruit. The plant is weak and straggling; a habit which, from other evidence, I find points to dispersal by creatures that brush past, a method that fits in excellently with the flat fruit and soft pappus. Considering the situation, generally moist and protected from gales, in which this species is found, it becomes clear that, while a pappus is of great value, in that it will cause fruits to be blown into the crevices of rocks or walls in the immediate vicinity, these are not likely to be carried very far by wind. When they become attached to birds, however,

long distances may be covered. It is significant that another species of Lettuce (*Lactuca saligna*) that grows

'Convergence' is another fact that helps to convince that there is a powerful influence at work, even among



On the left, fruit of the Groundsel (*Senecio vulgaris*), enlarged, also a larger magnification of two of the hairs on the fruit, showing the release of the mucilage; on the right, fruits of the Wall Lettuce (*Lactuca muralis*) and of another member of the family (*L. saligna*).



on shingle has a long beak on its fruit like that on the Dandelion.

Two kinds of transport are even better illustrated in the case of the Wild Michaelmas Daisy (*Aster*), that grows on salt marshes. A pappus ensures adequate wind dispersal but, in addition, at the base of the fruit there are also a number of delicate hooks which, assisted, no doubt, for a time, by the clinging of the pappus to the damp plumage, are sufficient to cause attachment to the feathers of birds. In the case of another denizen of the salt marshes, the Buttonweed (*Cotula coronopifolia*), a pappus would be quite useless, as this plant grows little more than an inch above the ground. Instead we find a heavy discharge of mucilage, ensuring that fruits will adhere to the feet of passing birds, and will remain until the bird alights on similar damp ground elsewhere. For plants growing by ponds, amongst rushes and sedges, a different structure is necessary and thus on the fruits of Bur-marigolds (*Bidens*) there are awns armed with beautiful downward-directed teeth ready to be caught on the feathers of birds rising through the herbage.

The common Groundsel (*Senecio vulgaris*) affords another excellent illustration of two methods of dispersal. Besides its pappus, it is provided with mucilage from the hairs covering the fruit, a transport mechanism which not only ensures adherence, but also serves for holding the fruit firmly until the radicle has entered the soil; thus possibly accounting for the rapidity with which this plant gets a foothold on bare soil and its success as a weed of cultivation.

minor features. Plants, often not nearly related, develop structures of considerable complexity, which act in similar manner though they may be developed from different parts. This, I suggest, can only imply that they have risen or been selected in response to similar requirements. Simple examples are provided by the pappus of the Compositæ and the cottony developments which occur on seeds of willow, willow herbs, cotton grass and reedmace.

My contention is, in short, that Natural Selection suffices to eliminate varieties which are not so organised as to reach a fairly high level of efficiency; and that in consequence we may expect to find that plants are closely adapted to their surroundings. To appreciate to the full the significance of the structures concerned it would, of course, be necessary to take account of all aspects of the life history, for, as was seen in the case of the mucilaginous hairs on the fruit of the groundsel, individual features may be advantageous to a plant at more than one stage.

The South Midlands.

The latest production of the Ordnance Survey—the tourist map of *Leicester District* (2s., 2s. 3d., 3s., or 4s. 6d. according to the mounting)—covers an area that is not well known to the general run of pleasure-travellers. It extends from Nuneaton (S.W.) and Corby (S.E.) to Repton (N.W.) and S.E. Lincolnshire, including the most famous fox-hunting country in England. The extensive railway-sidings in the S.E. corner show that the spreading steel-industry of Rockingham Forest has not gone unnoticed.

Symbolism in Modern Literature

By Gwendolen Murphy.

THE most interesting result, to many readers, of becoming familiar with *Axel's Castle*¹ is that certain modern writers hitherto accounted difficult and strange—difficult largely because strange—will now be seen as part of the main tradition of English literature. For Mr. Edmund Wilson clearly illustrates how W. B. Yeats, Paul Valéry, T. S. Eliot, M. Proust, James Joyce, and Gertrude Stein not only can be banded together as symbolists, but that symbolism itself, though of French origin, is a movement parallel to romanticism.

His idea of relating symbolism to our literary movements makes the subject more familiar to us than any previous treatment of it, in English or French. Though symbolism as a movement was French, and its theory was written in French, from Baudelaire who in 1847 was fired by his discovery of E. A. Poe, to Rémy de Gourmont in the eighties and Paul Valéry to-day, yet its practice was not unknown in England and America. Wilde, Symonds, Moore, and Yeats were interested and used to visit Mallarmé, one of its high priests, in Paris. Poe's interest in aesthetics gave him special importance in French eyes: but Hawthorne, Melville, and Whitman also showed affinities.

Mr. Wilson's pattern of the related movements is fascinating. Romanticism, led by Wordsworth and Coleridge, was a reaction to the classical school of Pope and Swift: their work was parallel to the development of mathematics and physical science by Descartes and Newton, which had resulted in a conception of the universe as an orderly machine. Symbolism, similarly, led by Baudelaire and Mallarmé, reacted to naturalism as found in Zola, Taine, Flaubert, or Ibsen: the symbolists were influenced by a new growth of biological science in the middle of the 19th century. Mr. Wilson adds an interesting prophecy: the new understanding of science and life, which relativity is gradually giving us, may yet develop symbolism and naturalism so that they become one, as at least one great experiment, in *Ulysses*, has suggested.

Literary Shorthand.

Symbolism is not to be taken in the ordinary English sense, as the cross stands for Christianity, or the definite ordered symbols in Dante. It is rather "an attempt by carefully studied means—a complicated association of ideas represented by a medley of metaphors—to communicate unique personal feelings." The point lies in

the parenthesis. Symbolism is a "literary shorthand which makes complex ideas more easily manageable." "Idea" seems sometimes too definite a term. Poe deliberately approaches the indefinite suggestion of music. In the symbolists generally, the real and the imaginary world, the perceptions of the senses were alike confused.

There was a significant difference in the second reaction: whereas romanticism had emphasised the individual as opposed to society (as in *The Prelude*), symbolism considerably developed this tendency by identifying poetry so much more closely with the more private sensations of the individual, sensations often super-sensitive or abnormal, that it often became foreign to the reader. Mr. Wilson works this point out clearly in the comparison between Anatole France and Valéry, the two writers typifying in this matter post-war and pre-war literature. For A. France was universally understood and popular, but Valéry tends to disregard the audience.

Yeats's early poetry is shewn to have much similarity to Mallarmé's; but Yeats had the advantage of finding symbols to hand in his native mythology. Important for drama was his getting Synge to work for the Abbey Theatre. Symbolism in the drama was not so important at first as in poetry. Yet, Strindberg, on returning to Sweden from Paris wrote, in 1897-1902, of "the symbolistic *To Damascus*, and *Dream Play*, the prototypes of the German expressionist drama." Maeterlinck has many examples, Yeats also.

The Position of Eliot.

T. S. Eliot was influenced by a different branch of the symbolist tradition. He has told us he began to write under the influence of "Laforgue, together with the Elizabethan drama." Jules Laforgue's "conversational-ironic" style could be "poignant-ironic, grandiose-slangy" and many examples, in Eliot's earlier poetry particularly, occur to us.

But less happy is Mr. Wilson's classification of Eliot among those symbolists who lived in dreams: Axel, Yeats (in this aspect only), Valéry, and Proust when he laments "the ineffectual, fragmentary imagination, the impotence and resignation of the poet of *Gerontion* and *The Waste Land*." This is not the final impression given even by those poems of Eliot's which most definitely illustrate the futility and anarchy in contemporary history. *The Waste Land* is distinguished by its dramatic qualities and its marked impersonality: distinguished too by the beautiful lines, still dramatic, which light it. Between the "broken images" and fear and the "famous clairvoyante" comes the line summing the personal memory of the hyacinth girl, "Looking into the

¹ *Axel's Castle. A Study in the Imaginative Literature of 1870-1930.* By EDMUND WILSON. (Scribners, 10s. 6d.; 2nd Edition, 1935.)

heart of light, the silence." Or later, after we have seen "the red sullen faces sneer and snarl," we hear the "sound of water over a rock Where the hermit-thrush sings in the pine trees." Mr. Wilson rightly said *The Hollow Men* "announced the nadir of the phase of sterility and despair." It is an Inferno, but the poet-guide carries with him other airs, for the keynote is in perhaps the loveliest passage Eliot has written:—

" Eyes I dare not meet in dreams,
In death's dream kingdom
These do not appear :
There, the eyes are
Sunlight on a broken column
There, is a tree swinging
And voices are
In the wind's singing
More distant and more solemn
Than a fading star."

The novel also was strongly influenced by symbolism if an influence so subtle and elusive can be thus qualified. Marcel Proust provides the first important example. Mr. Wilson's analysis of *A la Recherche du Temps Perdu* is the clearest and most attractive in English, and he adds an equally interesting account of "the metaphysics implicit in symbolism." For he explains how Proust's great dream-novel has supplied for the first time in modern literature an equivalent for the metaphysics based on the new theory of modern physics.

Relativity and the Novel.

James Joyce also was using the theory of relativity to give further perspective to *Ulysses*, published in 1922, the year of Proust's death. Symbolism helped him to express the consciousness of his characters. Admitted to their minds "we are in a world as complex and special, sometimes as fantastic or obscure, as that of a Symbolist poet—and a world rendered by similar devices of language." But, unlike Proust, he bases his work firmly on "naturalistic foundations." Mr. Wilson's account of these processes is stimulating: and his general picture and interpretation of the book is so just and discriminating that his criticism of it is important.

The last chapter explains the title. Axel was a super-dreamer who lived shut away from the world in a remote castle. His fantastic story was told by Villiers de l'Isle-Adam in *Axel*, 1890. When we hear it, the relevance is clear. But this grateful reviewer would plead for a title more explanatory to the large public who would welcome this original and admirably-written book.

The book concludes with an account of Dadaism and Surréalisme and a history of that movement by its chief promoter is in the Appendix. There is, too, a good index.

Scientists in the Post.

Among the very numerous recent commemorative issues of postage stamps, Science has not been forgotten. The Pasteur and Ampère issues of France are now, philatelically speaking, ancient history; more lately honoured are Von Guericke and Darwin. The two stamps depicted herewith were issued this summer by Germany and Ecuador respectively: the former commemorates the 250th anniversary of the death of the inventor of the "Magdeburg Spheres"; the latter celebrates the centenary of the voyage of the *Beagle*, the most famous ship in the history of Science.

Born on November 20th, 1602, Otto von Guericke, when burgomaster of Magdeburg in 1660, constructed the first frictional electric machine. It was he (says *The Electrician*, quoting Motteley's *Bibliographical History of Electricity and Magnetism*) who "heard the first sound and saw the first light in artificially excited electricity." He proved that "light bodies, when attracted by an excited electric, were immediately repelled by the latter and became incapable of a second attraction until touched by some other body; also that light bodies develop electrical excitation when suspended within the sphere of an excited electric."

Darwin's *Voyage of the Beagle* is too famous a masterpiece of English literature to need further reference here; and it is a graceful compliment on the part of the Ecuadorean Government that the exploit of a great British scientist should be thus officially honoured. Other denominations of the *Beagle* issue depict the fauna of Galapagos and give a map of the islands. A thrilling account of a voyage to this wonderful but inhospitable group is reviewed elsewhere in this issue.

Since the above was written, two more "Science Stamps" have been brought to our notice. The Netherlands Post Office, in their issue entitled *Cultural and Social Work*, commemorating the 400th anniversary of the death of Erasmus, have included a portrait of Kamerlingh Onnes, the liquefier of helium; and Yugoslavia portray Nikola Tesla, a candidate for the Nobel Prize for Physics, whose 80th birthday was celebrated in July.



The Year's Excavations at Lachish.

By E. N. Fallaize.

DURING the season 1935-6 the operations of the Wellcome Archaeological Research Expedition to the Near East, under the direction of Mr. J. L. Starkey, on the site of Tell Duweir, the ancient Lachish, 25 miles south-west of Jerusalem, were not merely confined to completing the clearance of parts of the site which had been attacked in the work of previous seasons, but in addition directed to the opening up of new ground. The results may seem incommensurate with the heavy work entailed; but this work nevertheless was essential before further progress could be made; and it has produced material which is of considerable archaeological interest and importance in confirming and extending previous conclusions.

Among the more important results which may be mentioned here are evidences bearing on the dating of Palestinian objects of the Bronze Age, a great quantity of skeletal material, evidence for the physical characters of the early inhabitants of Palestine, additions to knowledge of the religious cults of Lachish, which also point to a northern affinity, and the remarkable indications of what would appear to be the entrance to a subterranean tunnel, such as is known to have existed in other cities of ancient Palestine.

In completing the clearance of the saddle, on which the early Judæan tomb, containing the flesh-hook or trident for priestly use, was found last year, a small group of bronze bowls and other objects, much crushed, came to light in a quarry which had collapsed partially in ancient times. This group included a kohl-stick and mirror, the latter the first to be found on the site. These objects date from the Late Bronze Age, 1400-1300 B.C.

An Inscribed Censer-cover

Undoubtedly the most important discoveries of the season were made in the western valley in continuing the work of two years ago. A small tomb was opened which contained objects in far greater number than is often to be found in so restricted a space. They date from 1400-1300 B.C., or perhaps even as late as 1275 B.C., and include two hundred pots, of which fifty-three are types new to Tell Duweir. The most notable is a pottery censer, which, in paste and finish, resembles the now famous Tell Duweir ewer inscribed in the early Palestinian alphabetic script. On the upper side of its flat cover is a decorative design of incised tree or plant motifs within a hatched border, and on the underside is a further example of the script. Metal objects include a dagger with a long tang of an Egyptian

type of the XVIII Dynasty, lance heads, and a number of sporting arrow heads. A long ivory rod with a pomegranate finial is probably a hair curler. Faience draughtsmen are accompanied by the inlay plaques of bone of the wooden gaming board. Of the scarabs of Thothmes III and Amenhotep III, the former may be re-issues of the XIX Dynasty. A gold daisy pendant links up with a previous find in the XVIII Dynasty temple.

Masses of Skeletons

Another large chamber near by was entered through the roof. Its upper layers were a mass of rubbish, which belonged to the later Judæan period and possibly had accumulated during the Assyrian occupation. The lower levels consisted of a conglomerate of human skeletal remains, possibly representing salvage from the ruins after the sack of the city by Sennacherib, in 701 B.C. The bodies had been thrown in indiscriminately through the opening in the roof—the entrance on the west was discovered still blocked—and the skulls had rolled to the side from the top of the heap. A number of vessels, many intact, suggested that offerings had been made by surviving relatives.

The value of these skeletal remains for the light they will throw on the physical characters of the early inhabitants of Palestine is great, especially as, owing to the geographical position of Lachish, it is possible that a proportion may belong to the early Canaanitish population. A comparison of the results of the examination of this material with the measurements of the modern inhabitants will be interesting.

Skulls Deformed and Trephined

Among the skulls were numbers which showed head wounds and other pathological characters. Several afforded evidence of an artificial deformation which had produced a skull much elongated posteriorly, and thus resembling the shape familiar in the representations of Akhenaton. Remarkable evidence of the practice of trephining was obtained; and three interesting examples are those in which a piece of bone, about one inch square, has been removed by intersecting sawing cuts at right angles. This method is familiar in the trephined skulls from South America of Inca date, but had not been found hitherto in the ancient civilisations of the Old World. The surgeon had operated on the right parietal after a trial operation, of which the beginning is apparent on the left side.

At floor level it appeared that this chamber had been used as a dwelling place and an entrance had been made into the adjacent circular tomb, in which a further deposit of five hundred bodies was found.

Further clearance of the temple area produced some

interesting material from the middle temple, among which is a scarab of Queen Tyi, the consort of Amenhotep III, a hematite cylinder seal, on which the figures and symbols again suggest connection with northern cults, and a gold pendant embossed with the features of a bearded man. Under the altar bench, when the floor of the middle temple was removed, was found a large deposit of pottery, among which was a remarkably large bread platter, and a late Helladic II goblet of yellow paste, decorated with ivy leaf motif. This specimen, from the Aegean, dating from about 1450-1400 B.C., is of no little importance, as it links up and dates a number of Palestinian forms. A small chamber to the west now revealed may be the earliest vestry.

Three Successive Temples.

It is now possible to form some idea of the relation of the three successive temples. It is evident that the "lay-out" in all is virtually identical. The first temple was clearly much smaller than its two successors, a great expansion taking place in the building of the second temple. Judging from the deposits, an interval of ten years, but probably not more, intervened between the second and the third temples.

As regards the cult which was practised here, several features in the evidence now available point to the worship of a triad of deities, the familiar father, mother,



[Photograph by R. Richmond Brown]

Helladic goblet with ivy-leaf decoration

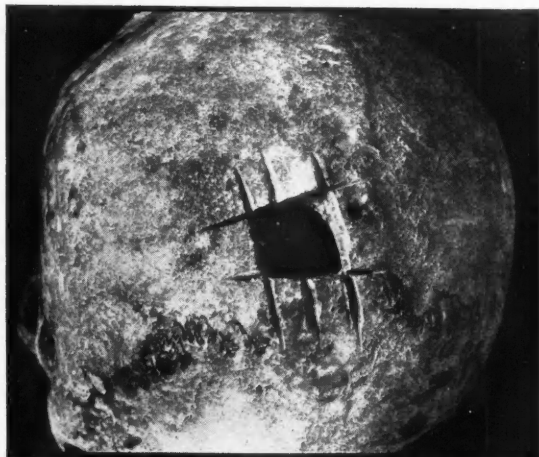
indications, leads Mr. Starkey to believe that this may have been the seat of a northern cult, possibly the worship of Sur, Mut, and Elat.

The examination of a depression at the south-east of the mound, in preparing for a clearance of a great rock-cut shaft, proved a much greater undertaking than was anticipated. At present two sides, one 75 ft. and the other 85 ft. long, of what appears to be the entrance to an underground tunnel have been cleared. It is suggested that the disappearing figures in the great relief of the siege of Lachish, now in the British Museum, may be emerging from this tunnel.

Finally, a brief reference must be made to the results obtained in a clearing within the city gate. Here, below the Persian level was found what was evidently the commercial quarter. The remains of structures were uncovered, which, from their contents, were evidently shops—a wine or oil seller's, a corn chandler's, and a weaver's, as was indicated by appurtenances appropriate to each occupation. A roof roller was identical in form with that in use to-day in Palestine.

The expedition was again financed by Sir Henry Wellcome, Sir Charles Marston, and Sir Robert Mond, and an exhibition of antiquities obtained was held at the Wellcome Research Institution during July.

[Earlier articles on the work at Tell Duweir appeared in DISCOVERY, xiv, p. 228; xv, pp. 231, 288; xvi, p. 235.]



[Photograph by R. Richmond Brown]

A remarkable example of the primitive surgeon's skill—a square-cut trephining, possibly an experimental operation on a captive

and son. The occurrence of a bronze statuette of Reshef, the war god, with right arm raised to wield a spear, or *khepesh* scimitar, at the level of the early sanctuary floor, in conjunction with other suggestive

Correspondence

LIGHT AND SOUND ANALOGY.

To the Editor of DISCOVERY.

Sir,—My attention has been called to the very interesting article, published in your issue of last April, on the subject of *Light and Sound Analogy*. Though necessarily restricted for want of space, it touches on most of the chief points round which the analogy turns. In the hope that your magazine will welcome further discussion of this subject, I beg to offer some remarks on the matter dealt with in your contributor's article.

It is, of course, impossible here to go into the reasoning which led Newton to postulate an analogy between the pitch relations, distinctive of the tempered diatonic octave, and the series of hue relations characterising the spectral series. But I would like to point out that his resulting colour scale was not based primarily on "the respective *lengths* of the colours in the solar spectrum" but on the refractive indices of the various sorts of rays which compose it. These refractive indices determine the lengths of the specific hue areas into which, by common consent, the infinite chromatic variety present in the spectrum is classified. The ratios found in terms of sines and angles, when translated into vibrational numbers, correspond fairly closely with the harmonic series of ratios distinguishing the diatonic octave.

The circular outline which has been adopted as a reference diagram for the spectral series has had the unfortunate result of confusing the natural serial order by the juxtaposition of its two most widely separated members, the purple and the violet areas. Introduced by Newton as a handy device¹ for estimating both hue and luminosity values, when a mixture of two or more hues takes place, it is now (under the name of the Chromatic Circle) unfortunately adopted as a statement of spectral hue relations. The anomaly of placing in juxtaposition the two extremities, *i.e.*, purple, which lies beyond red towards line A80 (thermal end) and violet, line H₁ and H₂, at the opposite end, has led to very obscure notions in regard to distinctions between the two colours, and the popular confusion between their names is all too apparent. By most scientists purple is held to be an impure colour, a mixture of red and violet, hence not present in the spectrum; but to colourists its presence in the series is apparent. This divergence of opinion is probably due to difference in colour perception.

Further confusion in popular thought on the subject of harmonic colour theory is increased by the introduction of the term "colour-music," used to describe "the display of mobile colour on a screen." This again is a purely mechanical device for presenting colours and musical sounds simultaneously. As, however, the association of the two appears to be quite arbitrary, its value as a contribution to aesthetic theory would seem to be nil, and the sole connection it has with music is its mobility.

The two "curious and interesting" psychological points to which your contributor referred at the close of her article, are important points, but they are not the only evident ones in favour of the analogy. In a hue scale, which recognises purple as a spectral unit, correlated with the note B in the diatonic scale, and in which the doubtful term indigo is eliminated, it has been shown² that the vibrational ratios can be distinctly correlated

with those of the tempered diatonic octave within the accepted margins of limitation. So much so, indeed, that it will be found on investigation to hold true of many other, though perhaps less obvious, intervals, than that of the "tritone." The subject is one that will bear much closer investigation than has been given to it hitherto and, for the artist at least, promises a rich harvest of results when dealing with problems of colour co-ordination.

Yours faithfully,

M. SARGANT-FLORENCE.

Marlow, Bucks.

BARISAL GUNS.

To the Editor of DISCOVERY.

Sir,—I should be much obliged if you or one of your correspondents would clear up my perplexity on the origin of the mysterious booming sounds, like distant gunfire, which may be heard in the Australian desert and suitable places all over the world. In Australia they are known as Barisal guns, probably because so many white men from India retire over here, Barisal being 50 miles from Calcutta, and the guns a familiar phenomenon in Calcutta.

I have heard the origin attributed to two causes: (1) cave formations; (2) swamp gas explosion. Both explanations present difficulties. (1) Cave formation seems to indicate firm ground, whereas all the Barisal part of Bengal has been formed from silt brought down by the Brahmaputra and Ganges, and the nearest hill is not less than 80 miles from Barisal. (2) The gas explosions are supposed to come from the swamps in the Sandarbans, but hundreds of craft regularly use channels to pass through the Sandarbans from the Hooghly to the Padma, and countless people spend days out on shikar in the Sandarbans network of waterways, islands, and mangrove swamps, yet nobody that I have heard of has ever witnessed one of these explosions.

Yours faithfully,

H. H. STEPHENSON.

Auburn, N.S.W.

DEVELOPMENTS IN ANÆSTHETICS.

To the Editor of DISCOVERY.

Sir,—I have just read an article on *Newer Developments in Anæsthetics* contributed to your last number, and I would like to make a few comments and to ask for information on one or two points.

In the second paragraph, I read that one of the ideals to be aimed at is a "speedy production of unconsciousness and quick recovery rate." Is this really so? One of the great points in favour of the use of Avertin is that when it is given the patient goes gradually to sleep some half hour before the operation is due to take place and wakes gradually some four or five hours after the operation. The fourth paragraph describes the giving of an appropriate amount of Avertin "dissolved in olive oil." I personally gave the first rectal injection of Avertin in this country, and have used it regularly for eight years, but I

¹ *Opticks*, Bk.I: Part 2: Pl. III: Fig. ii.

² R.S.A. Paper on "Colour-Co-ordination" (read Nov. 29th, 1933).

he accepted
will be found
high perhaps
The subject
an has been
mises a rich
colour co-

ly,
LORENCE.

your corres-
igin of the
which may
es all over
s, probably
ere, Barisal
a familiar

(1) cave
explanations
dicate firm
een formed
anges, and
l. (2) The
mps in the
channels to
he Padma,
andarbands
amps, yet
ne of these

HENSON.

S.

opments in
uld like to
one or two

als to be
and quick
points in
he patient
eration is
r or five
cribes the
ed in olive
Avertin in
ars, but I

have never before heard that olive oil was to be used as a solvent. The routine method is to make a solution in distilled water. Olive oil is used as a carrier for ether when given *per rectum*, and I would like to have particulars of its use with Avertin.

Paragraph five discusses "Nembutal" and "Pernocton." The latter I know nothing of, unless perhaps your printer means "Pernocton." However, a capsule of Nembutal (which may contain either $\frac{1}{2}$ grain or $1\frac{1}{2}$ grains of the drug) will, if given to a full size patient produce nothing more than a slight drowsiness, and, unless the cases be one of extreme cachexia, toxæmia, or shock, would certainly not produce a "degree of unconsciousness sufficiently deep for the operation."

Paragraph eight describes "Vinethene" as being "mixed with CO₂ and delivered from a gas apparatus." Is the poor patient to have no oxygen or even air to maintain his metabolism?

Paragraph eleven mentions a "closed circuit" as the medium of delivering gas and air by the Minnitt apparatus. This is not so: in a "closed circuit" the expired air and anæsthetic gases and vapours are conducted back to the apparatus, and then purified before being returned to the patient. In Minnitt's apparatus the expirations escape into the air. True the anæsthetic is administered by a "closed" method, (or, as air is allowed to mix with the nitrous oxide delivered from the cylinder perhaps even that is not strictly accurate), but certainly there is not a "closed circuit."

Finally, we are told that "it is very likely that the near future will see a notable advance in the knowledge and practice of general anæsthesia." This may be so; I hope it will be so; but can you give any reasons for thinking that such notable advance is probable?

Now, Sir, there are many other points on which I might have expressed carping criticism. I do wish that before you had published the article in question it had been edited by some practising anæsthetist. Too many of our patients come to us with impossible demands based upon various inaccuracies in the statements made in the lay press.

Yours faithfully,

London, W.14.

ANÆSTHETIST.

To the Editor of DISCOVERY

Sir,—I thank your correspondent, "Anæsthetist", for troubling to draw my attention courteously to certain points in my article *Newer Developments in Anæsthetics*.

I am grateful for the opportunity to correct the unintended erroneous statement that Avertin is administered dissolved in olive oil when I should have written, distilled water. I believe it is on record that in the early study of Avertin, Gwathmey did consider an olive oil solution, but that this was shown to be unnecessary, as Avertin, unlike ether, does not irritate the rectum.

I also agree that a "gas-apparatus" is more correctly described as "gas and oxygen" but in ordinary speech one constantly hears the former term used, and it is understood by most people to refer to gas and oxygen apparatus.

In regard to "the speedy production of unconsciousness and quick recovery rate," I think that "Anæsthetist" and myself really have the same idea in mind; viz.:—that whereas from a drug standpoint the induction and recovery are gradual, from the patient's point of view (which is the one implied in my article), there is no distinction, in his sensations, between apparently natural sleep and recovery, and the period of actual

induction, and recovery from anaesthesia—that is, in the case of the drug in question, all he experiences is an *apparently* short and satisfactory sleep.

In regard to Nembutal, I had in mind that it is often the anæsthetic of choice for a cachectic, highly nervous patient as eliminating the stage of mask anæsthesia in an anæsthetic room which is so often a source of acute apprehension. But then one would choose the minimum dose of Nembutal even if some ether anæsthesia be needed later when mental perception is dulled, rather than give a larger dose of the drug, say 5-6 grains, with the possibility of respiratory depression and lowered blood pressure.

With regard to the term "closed circuit" in describing the Minnitt apparatus, one is aware that the term is not *strictly* descriptive, but one used it as more easily and accurately conveying to the lay reader the meaning of what is correctly described as a closed *method*. The term has been used by a qualified anæsthetist in a text book on anaesthetics, but I, unfortunately, cannot now trace my reference.

Finally, the reasons for believing in a future development of the art of anaesthesia.

Surely this will follow by reason of the increasing tendency to demand abolition of pain without supervention of unconsciousness, and also as a natural sequel to the increasing use by surgeons of subcutaneous, spinal, and intravenous anaesthesia for all types of operation. The indications are that "local" injections have an increasingly important space to fill in the near future.

It is but recently that the science of anaesthesia has ceased to be the Cinderella of medicine, and it is but reasonable to believe that it will go all out to justify its existence in these days of intrathoracic surgery, and the deep implantation of radium.

Yours faithfully,

MARY G. CARDWELL.

Oldham, Lancs.

CONCERNING THE DIVINING ROD

To the Editor of DISCOVERY.

Sir,—In the April issue of DISCOVERY you printed a short article on *The Physics of the Divining Rod* by Mr. E. Christie, which would appear to call for critical discussion almost line by line, if one were fairly to examine the omissions and commissions made by its author. As, however, there is no room for such an analysis in the short space of a letter, I shall have to content myself by reminding those of your readers who do not happen to have interested themselves especially in the subjects of dowsing and divination that an already extensive literature of the latter exists, dealing with both the physical and psychical aspects of these matters, which it would be well for any prospective student to examine before permitting himself to be prejudiced—in whatever way—by Mr. Christie's remarks.

Mr. Christie, like many other practising diviners and dowisers, is evidently too strongly biased by his personal observations and subjective sensations, on the one hand, and by certain preconceptions as to what is known as radiesthesia, or radiation perception, on the other, to enable him to view—much less expound—these problems in a clear and impartial light. Indeed, as in other branches of scientific research into the (seeming metaphysical) mechanism of thought and sensation, with phenomena such as telepathy and telesthesia, and various other as

yet occult matters, which Parapsychology and Psychic Science are now seriously investigating, the phenomena of dowsing and of divination may be said to call for critical capacities as well as wide technical and experimental experience in the investigator, such as are lamentably rare. In short, an extensive knowledge not only of Physics and Physiology, but also of Psychology and Parapsychology are here called for. Besides, it is not possible for anyone, no matter how expert, to present a fair picture of the phenomena of dowsing and divining in the space of a few hundred words, such as Mr. Christie has attempted to do, especially to non-specialised readers, who can only be misled or else—and which is worse—definitely antagonised by dogmatic statements of the sort in question.

Actually, careful observation of a number of professional and amateur dowsers and diviners over a number of years and a concentrated laboratory investigation of these and allied phenomena during the last three years, has shown me, personally, at least one thing that does not appear from Mr. Christie's article; namely, that the situation is by no means so simple and definite as he would have us believe. Although I do not wish to scout Mr. Christie's ideas entirely, it is incumbent upon someone or other to point out that the facts which he cites may well be found, ultimately, to be more apparent and subjective in origin than real and objective. For many hundreds of similar definite observations and correspondingly dogmatic statements have been made in the past, and are still being made, by perfectly honest-minded and intelligent diviners, which, however, on careful analysis and laboratory observation are seen to fall to the ground; being, almost invariably, the outcome of intellectual preconceptions (even though based on certain preliminary personal observations), which then autosuggest to the subject some coherent, and often highly complex, scheme of interpretation with which his subsequent muscular reflexes subsequently concur. Many similar instances of the remarkable power of such hypotheses, *via* auto-suggestion, are known to psychologists: Blondlot's N-rays, for example, which were acknowledged by a number of physicists, until the American physicist, Prof. Wood, finally exploded the idea.

In the investigations in my laboratory, we have had constantly to guard against and make allowance for auto-suggestions and personal inhibitions of various kinds in this work. Thus, so long as I had in mind the idea that electrical "earthing" of my body, for instance, or sitting with relaxed muscles in a wheel-chair (suggested by Dr. G. A. M. Lintott, of Guy's Hospital) inhibited the dowser's reaction to water, etc., I got no reactions, nor did another subject. But directly we found that a fresh subject (uninformed of these hypotheses) was not so affected, then we at once became reactive again! Other dowsers imagine that they cannot work in rubber boots or gloves, or when walking on glass, etc. But all these effects, as well as those connected with the carrying of samples of the substance that one is searching for, as practised by many true diviners—who appear to work by some form of cryptopsychic faculty allied to clairvoyance—can be shown to result from psychological inhibitions and predispositions. Many treatises on divining, such as M. Henri Mager's *Water Diviners and Their Methods*, provide countless instances of confusion arising out of individual psychology, so will a critical reading of the *Journal of the Brit. Soc. of Dowisers*, in which it is possible to perceive a sharp demarcation between what may be called "straight dowsing" and "divination proper." Unfortunately, Mr. Christie, in his article, takes no account of these pitfalls and hindrances to the critical analysis of the phenomena. There are also certain inconsistencies of

expression, and the writer permits himself full—others would say, unjustifiable—licence in the use of physical terms in speaking of phenomena of an uncommonly subtle and still uncomprehended kind, and whose true basis appears to lie in the psychical rather than the physical realm. This apparent fact was realised by Sir W. Barrett and Mr. T. Besterman in their book *The Divining Rod*; and my own observations have satisfied me that, although almost everyone can, with practice and proper encouragement, become an ordinary dowser, in some degree, by virtue of certain physiologically evoked muscle reflexes, the subject is rare who can specify the depth, nature and volume of a hidden object. Such a subject may fairly be called a *diviner*, as contrasted to the ordinary *dowser*. His methods are also distinctive, and he becomes fatigued in a way that the "straight dowser" never does.

The true diviner carries samples, and has all sorts of personal foibles and tricks of technique that are his individual business, and which do not hold good, universally, for others. He is, in fact, what in another sphere would be termed a clairvoyant. Indeed, the feats of the body finders—who have been so successful both at home and on the Continent recently—are clearly allied to those of the professional "psychometrist." Some advanced diviners can even carry out distant prospecting of a given geological field, sitting at home with only a map before them. We have also succeeded in showing in my laboratory that telepathic auto-suggestion can be made to work the rod in the complete absence of any physical (hidden) object. So that a sensitive subject can be made telepathically to imagine the existence of phantom streams or what-not. In view of such facts, a purely physical explanation of divinatory phenomena becomes extremely unlikely, and the major problem—apart from the "straight dowser's" muscular reflexes, *afore-said*—is shifted into the sphere of Parapsychology, where many of the more acute investigators have long suspected it to belong.

On the physical side, much has been said both with and without reason by the continental schools of *radiesthésie*, and workers such as Regnault in France, Dobler and von Pohl in Germany, and Lintott, Franklin and Budgett in England have been able to demonstrate various physical and physiological effects in connection with dowsing that are of real interest; though it is very possible that the rays and emanations that they believe that they have detected may not coincide with those that affect the dowser's muscular tone. Still less likely is it that the complex information obtained by the true diviner—so often erroneous and indefinite, be it noted—will be explained in terms of radiation perception. The present writer happens to have given a considerable number of physical apparatuses, that were claimed to detect this or that sort of radiation, a full and critical testing in the laboratory, including various dowsing appliances, and so far not one has justified itself; though a few did, indeed, give *some* reaction or dial reading, but which could be traced to secondary causes not under examination. Others, however, obviously only functioned in the hands of a clairvoyant; and it is not to be denied that such persons can and do get remarkable results with such appliances, on which they pin their faith, whether merely a simple divining rod or a complex electrical affair with two or three stages of thermionic amplification. But the magic is in the operator, not in the apparatus as such.

Exceptions to the foregoing statement must be made, however, in the case of an electrical detector apparatus constructed and used successfully by Mr. T. Bedford Franklin for the diagnosis

(continued on p. 255).

The March of Knowledge.

The discovery of a new wild flower in Wales, by a forester of the Forestry Commission, is reported in *The Morning Post*. **New British Wild Flower** *Gaura coccinea*, the new immigrant to Britain, appears to have established itself on Pembrey Burrows, on the Carmarthenshire coast. It has attractive red blossoms and its nearest native relation is the common Rose-Bay Willow Herb. It is suggested that it may have been imported in packing during the War, when a powder works was established on the Burrows.

The unearthing of an inscription of dedication at Halton Chesters, Northumberland, from the gate of one of the forts of Hadrian's Wall, which were replanned after the actual wall was completed, settles the question of how long it took to build the wall. The name of Platorius Nepos appears on the tablet, and it is known that he was governor of Britain in 122-126, and that he directed the first stages of the building of the Wall. It may therefore be safely concluded that the Wall was completed within the five years of his governorship. The dedicatory tablet, which was discovered by the University of Durham Excavation Committee, was illustrated in *The Times* on July 13th.

Bricks, safety-razor blades, gramophone records, and wool are a few of the many articles which are now being made from glass. Glass bricks are very strong and have the advantage over ordinary bricks of being transparent; rooms built with glass bricks therefore need no windows, unless of course, a view is desired. A block of offices built entirely from the new glass bricks attracted considerable attention at a recent American exhibition. Glass razor blades can be ground to powder under foot when used, and thus constitute a solution to a very old problem. Gramophone records made from glass are said to be stronger than ordinary records, and to reproduce with less distortion. Glass wool has, of course, been known for many years, but it has only recently been employed in the weaving of beautiful new fabrics.

Of the numerous substances which have been suggested from time to time as antidotes against carbon monoxide poisoning the latest to be investigated is hexahydroxyferric chloride. In tests recently carried out in America on rats suffering from carbon monoxide poisoning, 75 per cent.

of the animals recovered when treated with this new antidote. Coal gas and motor exhaust fumes, both containing carbon monoxide, still continue to take toll of many lives, and no effort should be spared in the search for an efficient antidote against this deadly gas.

A new way of killing mosquitoes, recently reported from South America, involves the use of hexachloroethane. The compound, mixed with talc powder, is blown on to the surface of the water in which the insects breed, where its vapour immediately kills the larvæ. Any unused hexachloroethane vaporises away, leaving the water uncontaminated. In this respect the new method has a considerable advantage over the older oil-film method.

An American invention to enable the blind to read faster, now being tested at an Illinois University, may render the fatiguing Braille system obsolete. It is a compact instrument which will stand on a table. The printed letters are first magnified four times normal size, then communicated by electrical contact to the sensitive finger-tips of the blind reader, without effort.

A National Congress of Byzantine Studies, the fifth held so far, will take place at Rome from the 20th to the 27th of next September. The Congress will be under the patronage of the King of Italy and it will be presided over by the Minister of Public Education.

(continued from p. 254)

of subsoil strata, as well as in that of Mr. H. M. Budgett's experiments in the detection of a vertical ionising radiation from the earth. But both of these methods of detection depend upon certain recognised and more or less straightforward physical processes. Moreover, they suffer from certain grave limitations that do not restrict either the ordinary dowser or, still less, the true diviner. And the same thing can probably be said of the photographic methods of "earth-ray" detection recently promulgated on the Continent. Hertzian waves from human broadcasting stations and geological radioactivity respectively appear to be responsible for the effects in question.

In conclusion, may I suggest that, lacking a series of comprehensive articles from authoritative sources, it would be more profitable for readers of *DISCOVERY* who happen to be interested in this subject to study one or two standard works on divining, or else to join the British Society of Dowsters and read its Journal, excellently edited by Col. A. H. Bell, which gives full news and views relative to its especial subject.

Yours faithfully,

Biophysical Laboratory,
Bourton-on-the-Hill, Glos.

J. CECIL MABY.

Against CO Poisoning

Chinese Origins.

By A Special Correspondent.

Recent discoveries throwing a new and comparatively clear light on the earlier annals of China—the Bronze Age period—are the result of excavations during the last few years at Anyang made first under American and later under Chinese auspices. Our summary of the results, however, shows that there is still a wide field open for further research.

IN the last few years China has been almost as much to the fore in the news of the archaeological world as it has been in the political. While, however, the significance of the discovery of Peking Man has been made plain to a wide public, it is less generally known that there have been accessions to knowledge of the early



Bronze ritual vessel from Anyang, with an enlargement of the decoration which has striking affinities with Maya designs.

[By courtesy of Messrs. Jonathan Cape, Ltd.]

stages of culture in China, which, in truth, are amazing, and if extended in directions which now seem possible, may have a profound effect on current views of the growth and relations of early civilisations. To Peking Man we must add palæolithic man of a type associated in Europe with the Aurignacian phase of the Old Stone Age, and the culture of a Neolithic Age, in which a painted pottery is the extreme link in a chalcolithic ceramic chain extending to India, Susa, Mesopotamia, and Southern Russia, as well as a bronze culture which attains a perfection in the technique of metal-working such as is surpassed nowhere.

On the origin and affinities of the Neolithic civilisation of China it is difficult to arrive at settled conclusions in the light of present knowledge. This much, however, seems fairly certain: three distinct types of culture in chronological succession are distinguished in the evidence which has accrued since 1921, in excavations on a large number of sites in Northern China. Of these three types or phases, the second in chronological order is the culture of the painted pottery, and on both internal and external evidence it is probable that it originated in the West; while the latest in date and the most recently discovered, the "black pottery culture" from Shantung, discovered in 1930 and 1931, not only presents features new to China, but also in a number of details affords affinities with later forms and technique, which make it appear a connecting link between the Neolithic and the known culture of the succeeding Bronze Age.

This is the view to which Dr. H. G. Creel, of the University of Chicago, lends his support in a valuable descriptive analysis¹ of recent archaeological discovery in its bearing on the history of Chinese cultural development. With this period, it is true, Dr. Creel deals only briefly, and, pending further evidence, the situation is perhaps too obscure for more than a summary setting out the main outlines. Dr. Creel, holding firmly to the indigenous development of Chinese civilisation, contributes to discussion the suggestion that there were two great centres of cultural diffusion in the early world,

¹ *The Birth of China: A Survey of the Formative Period of Chinese Civilization.* HERRLEE GLESSNER CREEL. (Jonathan Cape, 1935.).

Age period—
under Chinese
research.

are amazing,
them possible,
views of the

To Peking
e associated
e Old Stone
in which a
chalcolithic
Mesopotamia,
culture which
etal-working

e civilisation
conclusions
th, however,
f culture in
the evidence
s on a large
these three
order is the
th internal
t originated
d the most
" culture"
I, not only
number of
technique,
between the
succeeding

eel, of the
a valuable
l discovery
al develop-
deals only
situation is
ary setting
mly to the
ation, con-
e were two
arly world,

ve Period of
(Jonathan

of which one was in Western Asia and the other in the east, the evidence for the latter pointing on the whole to North-East China. Its influence is to be discerned in the Pacific, on the north-west coast of America, and in Central America in the culture of the ancient Maya. Without entering into the discussion of this intensely interesting problem, it may be remarked in passing that Dr. Creel's suggestion, well grounded though it may seem at first sight in cultural, and especially artistic, resemblances, gives rise to a number of chronological issues, which need fuller consideration.

For Dr. Creel, however, discussion of the Neolithic age in China is little more than a preliminary. His main objective is the "formative period" in China, the period from about 1400 B.C. to 600 B.C., as revealed in the evidence of the Bronze Age civilisation recently discovered at Anyang, in the Province of Honan, North China, and in its bearing on the records of the two dynasties of Shang, or Yin, and Chou.

To appreciate the remarkable results of the excavations at Anyang, which have been carried on since 1928 by the Chinese National Research Institute of History and Philology, it is necessary to bear in mind that, while European sinologists have regarded Chinese history as beginning at the earliest with the Chou dynasty, and many, indeed, have been inclined to accept little as authentic before the 6th or at most the 7th century B.C., the Chinese themselves hold traditions which go back to the earlier half of the third millennium B.C., and accept the evidence of annals, in which, following on the Hsia dynasty, which was founded towards the end of the third millennium, the Shang dynasty begins at 1765 B.C., lasting until 1122 B.C., and this is then followed by the Chou dynasty, which ended in 256 B.C.

A vast store of objects of bone and bronze from the site of Anyang—of the inscriptions alone some 15,000 out of over 100,000 have been published in facsimile—has confirmed the existence of rulers of the Shang dynasty mentioned in the annals, and at the same time has corroborated the evidence of inscribed bronzes and the like, of which the historical significance had been thrown into doubt previously, in default of confirmation of the very high antiquity claimed for them, the passion of Chinese and European collectors for antiques having caused the markets to be flooded for many years with pieces both genuine and forged.

The first clue to the existence of Anyang, which, as it



"Oracle bones" with inscriptions of the Shang period. These primitive characters have thrown a new light on the development of Chinese writing. The upper left hand inscription is a forgery.

[By courtesy of Messrs. Jonathan Cape, Ltd.]

has turned out, was the capital city of the Shang, was afforded by the Chinese faith in the efficacy of "dragons' bones" as medicine. Just as the tooth, which led ultimately to the discovery of Peking Man, was found among the fossil bones exposed for sale in a chemist's shop to be ground up for this use, certain bones exposed for the like purpose were found to be inscribed with markings, which were identified in 1899 as a primitive form of Chinese script. When interpreted, after much study, these inscriptions showed that the bones had been used for divinatory purposes and were part of the royal archives of the Shang dynasty.

Excavation at Anyang under the National Research

Institute, acting in co-operation with the Freer Gallery of Art of the Smithsonian Institution, Washington, D.C., began in 1928; but, meanwhile, the site had suffered severely at the hands of grave robbers. Civil war interrupted the work for a time, but it has been resumed by the Chinese independently, and in the season 1934-5 a serious attempt was made at scientific excavation on a large scale in an extensive burial ground. This has produced remarkable and revolutionary results. For the first time Shang objects have been accurately dated, in the archaeological sense, and for the first time evidence has been obtained of the physical characters of the early Chinese in material afforded by the exactly dated skeletal remains of eleven hundred individuals, many in an excellent state of preservation. Three hundred tombs, of which four, of vast size, are undoubtedly royal, have been excavated scientifically. Bronze ritual vessels were found by the score and an entirely unsuspected art of sculpture was brought to light. From the inscriptions on bone, tortoiseshell and bronze, from the weapons and utensils, notwithstanding the fact that conditions of Chinese soil and climate are unfavourable for the preservation of many classes of antiquities, a remarkable flood of light has been thrown on the language, social organisation, and history of this early period of Chinese civilisation.

Not the least important result to emerge is the confirmation of the age of the remarkable skill and artistic achievement shown in the bronzes of the period. As already mentioned, they are unsurpassed. In short, Anyang has revealed the existence of a people who attained a degree of artistic development and material and intellectual culture at least equal to any of their contemporaries in the ancient world.

It is unquestionably premature to attempt any discussion of the source of this remarkable civilisation. Dr. Creel, as already mentioned, strongly advocates the view for the indigenous development of Chinese culture; but it is difficult to accept that view of a culture which appears full-fledged as does the bronze age of the Shang dynasty, even admitting the "black pottery culture" as in some sort a connecting link. It is true that the present discoveries do not go so far back as the beginning of the Shang period, and evidence of a less-developed phase may appear. Yet, in the painted pottery of the Neolithic age is evidence of connection with the chalcolithic culture of the west, and among the hints of a western relation there are points of strong resemblance in the royal burials.

In the following period under the Chou dynasty, to which Dr. Creel devotes the latter half of his study, a feudal system ended with the consolidation of the Chinese world under Duke Huan of Ch'i, in 679 B.C.

It was under the Chou dynasty that Chinese intellectual development, especially in literature and philosophy, attained its highest achievement. Political influence and administration passed to the scholar, and principles were developed in government and social organisation, which have preserved the continuity of Chinese culture for two thousand years and more. In this period, in which Dr. Creel re-interprets the evidence with no less skill than he has shown in dealing with the Shang dynasty, the interest is historical rather than archaeological. For the Chou, when they finally conquered the Shang in 1122 B.C., adopted Shang culture wholeheartedly. What they made of it—and the results are by no means to be contemned—will be remembered by all who visited the recent exhibition of Chinese art at Burlington House.

Caucasian Studies.

Welcome indeed is the organ* of the new organisation for the promotion in this country of the study of that ancient Christian people the Georgians, and of the whole of that fascinating land of problems, the Caucasus, about which we are so ignorant.

For the number of Englishmen, as we are reminded by Sir Denison Ross, first President of the society, who have known the Georgian language is lamentably small. Few realise that the Georgian tongue, with its ancient ecclesiastical literature and peculiar script, is not related to any other group of languages in the north. It is in fact *sui generis*, and to most Europeans, unpronounceable.

The first number begins well with a sketch of the present state of Caucasian Studies, by W. E. D. Allen; discussion on Georgian chronology, by Professor Taqaishvili; an article on the Asianic elements in Georgian Paganism, by Professor Tsereteli; a description of a piece of 15th century Georgian needlework, by Z. Avalishvili; an account of the Holy Lance of Echmiadzin, by the veteran writer on Caucasian affairs, J. F. Baddeley, who considers that it is identical with the Lance discovered in the siege of Antioch in 1098, supposed by some to have been the original weapon which ribald Jews thrust into the side of Our Lord upon the Cross. Archimandrite Peradze gives an account of some Georgian MSS. preserved in England, of which the collection formed by Sir Oliver Wardrop, now in the Bodleian Library, is the most important and richest in Europe. G. Chitala illustrates his description of the ceremonial chair of the Svans, while A. Gugushvili contributes an article on the difficult subject of the classification of Georgian sounds, and also a notice on that remarkable son of an Aberdeen gardener, the late Professor Nicholas Marr, author of the theory of Japhetic languages.

Mr. Gugushvili is Hon. Secretary of the Georgian Society, and all enquiries should be addressed to him at Commonwood House, Chipperfield, Herts.

M.B.

Georgica (Vol. I, No. 1), a journal of Georgian and Caucasian Studies (Published by G. Stephen Austin & Sons for the Georgian Historical Society).

Book Reviews.

Voyage to Galapagos. By WILLIAM ALBERT ROBINSON (Cape, 8s. 6d.)

This thrilling book tells how *Svaap*, claimed to be the smallest vessel which ever sailed round the world, was taken by its owner on what proved to be its last voyage. (Unless, of course, he succeeds in getting the ship back from the Ecuadorean Government, a task which ought not to defeat one who has so often achieved the seemingly impossible.) Mr. Robinson looks upon this voyage to Galapagos as ill-fated, and so it was from the standpoint of practical difficulties; but from another angle he was surely most fortunate. Few explorers can ever have enjoyed their travels more, and not one in a thousand would have escaped the death on a tropical island from which he was saved just in time by some seaplanes of the United States Navy. To describe the adventures and misfortunes which befell *Svaap* would be unfair to the reader, for the charm of this book lies largely in the unexpected.

Although the author confesses that his passion for sailing may be due to his having been "born two hundred years too late," for he believes that only in a small ship can the emotions of the pioneer be recaptured, the purpose of this voyage to Galapagos was to photograph the life of the islands. Many of the species have been sadly depleted since Darwin paid his epoch-making visit in the *Beagle*. It is estimated that no less than ten million of the giant land tortoises, which originally populated the islands in incredible numbers, have been taken in the past half century. Yet the variety of species available for study is still unique, and Mr. Robinson, with the aid of his wife and Mr. West (who completed the crew), spent several months working with cinema cameras before their stay was suddenly cut short by illness.

They became very friendly with all the animals except some wild dogs, which had eventually to be shot: this is how the author describes an early morning bathe. "As soon as we threw off our clothes and plunged in, the sea lions would come to play, darting around and under us with great enthusiasm. The pelican would dive from his perch now and then when we started up a school of small fish. Our little pair of penguins would join us, and perhaps a big marine iguana would be swimming there too. The peeper bird preferred to sit disconsolately on the gunwale of the canoe. I would take a long dive under water, open my eyes, and find one of our penguins, with his head stretched forward, examining me intently. Then we would both come up for air, each thinking what an odd looking fellow the other was."

In addition to the Galapagos fauna, the species met with in the Humboldt Current are vividly described. Anyone who has observed the fishes, seals and birds of "Equatorial Antarctica" from the deck of a liner (the nearest that most of us come to exploration) will specially enjoy the more detailed picture afforded to the crew of *Svaap*, sailing along the coast of Peru at a more leisurely speed. The prolific life of this famous current is based on the cold up-welling polar waters which bring to the surface, and thus to the diatoms, an endless source of food in the form of decomposed material from the bottom. On the plentiful supply of diatoms, fish and crustaceans feed in huge numbers, in turn being devoured by the enormous flocks of sea birds that provide the guano deposits. As with the turtles of Galapagos, the guano deposits were attacked by greedy exploiters at such a rate that the coasts were in danger of

being denuded, both of this valuable fertiliser and of the birds which provide it. Fortunately, the Peruvian Government intervened in time, and to-day the deposits are officially supervised. Mr. Robinson pleads that similar steps should be taken in Galapagos, and it is believed that plans for protecting the fauna of the islands are now under consideration by the Ecuadorean Government.

The descriptions of scenery throughout this last voyage of *Svaap* are among the best of many brilliant passages. It is a book for all who love adventure, and though containing little that is new to science, it will be of interest to every biologist.

Antarctic Discovery. By Rear-Admiral RICHARD E. BYRD, U.S.N. (Putnam. 18s.)

This is the story of the Second Byrd Antarctic Expedition—a that expedition of which (it is said) a member complained because there were no "adventures." Certainly, Admiral Byrd's gift for organisation saw to it that no serious mishaps occurred; but the whole expedition was a colossal adventure in itself, and Byrd's lonely vigil at the Advance Base from March 28th to October 12th, throughout the long Antarctic winter, will surely rank among the great single-handed exploits of geographical science. For nearly a month—from July 5th to August 2nd—he was unable to work his radio communication and so was completely out of touch with the outside world.

The whole story is exhaustively told, every detail noted down with the naval precision of a warship's log. This, perhaps, does not make for entertaining reading, but it vastly enhances the value of the book as a scientific document. The photographic illustrations are copious and explanatory, but the maps leave something to be desired. Mr. Claude A. Swanson, in the Foreword, puts readers greatly in his debt, as he gives us an idea of what manner of man led the expedition, which Admiral Byrd's impersonal modesty would never allow him to do.

Odyssey of the Islands. By CARL N. TAYLOR. (Scribners. 12s. 6d.)

Armchair travel becomes easier and more pleasant every day, and this book is directed more to the occupiers of those armchairs than to eager seekers after knowledge. It is the book of a journalist, and all is subordinated to effect. It is, however, an interesting work, dealing with parts of the Philippines which have not received a great deal of attention. It is supported by a number of really excellent photographs, which, especially in the case of the Sea Gypsies of the Sulu Sea, will appeal more to the anthropologist than will the text.

Ocean Island and Nauru. By ALBERT F. ELLIS. (Angus & Robertson. 7s. 6d.)

No ordinary criticism can be applied to *Ocean Island and Nauru*. Some parts may drag, others may sicken with their pedestrian phraseology; but it is a monumental work. The

author is no globe-trotter, writing of what he has seen and heard. He is a working man writing of his work, which is his life. Albert Ellis knew Ocean Island when it was just emerging from the state of primitive tribal strife. He "discovered" Nauru as a phosphate island. For the thirty-odd years since those days he has been working phosphate, and as he traces the progress of the industry from the time when the first truck-load of the Ocean Island tramway overshot the jetty and plunged into the sea, to the present day when the Nauru cantilever loads a 6,000-ton ship in a day, he holds the reader's interest without once resorting to exaggeration or romancing. He sketches the native life, the quarrying, loading, and every side of the work, telling a plain story in a plain way. Therefore he must be excused for what the book lacks, for he has done a remarkable thing in telling a genuinely convincing story of these Pacific islands.

The book lacks a good map. The only key-map is useless, as it carries no scale. Then there is a want of coherence about the first part, in which the early history of the islands is sketched.

Finally, about the last part, describing life to-day, there is a lack of critical faculty. One dislikes to say "smug," but one almost feels Mr. Ellis is trying to "sell" us Ocean Island. The middle part, however, describing the progress of the islands from unknown atolls to Commission-governed colonies, is excellent. Were it not for the remoteness of the islands, this book would bring many visitors to see this earthly paradise, where unemployment does not exist, and the few motor roads are metalled with high-grade phosphate!

Cradle of the Storms. By BERNARD R. HUBBARD, S. J. (Harrap. 8s. 6d.)

In 1867 the U.S.A. acquired Alaska from Russia for a sum of seven million dollars—which works out at just under two cents per acre. The Russians probably thought the price was quite sufficient for a land of snowfields and volcanoes. Thirty years later gold was discovered in the Klondyke and the economic penetration of Alaska began.

The popular conception of the country as an Arctic Province is not quite correct. Much of the land has a temperate climate, and there is a large area fit for permanent settlement, with arable land, forests, and considerable mineral resources. Moreover, in modern days the growth of long-distance air transport again brings Alaska into prominence, for the shortest (Great Circle) route from New York to Tokyo cuts across the middle of the country. Before long Fairbanks is likely to become a great world air-port. This air route does not cross the western cordillera—it runs parallel to the coastal chains—and the weather conditions for flying are excellent.

The reader of Father Hubbard's new book will not, however, find anything about these sombre geographical facts. The author, described as the "Glacier Priest," is interested mainly in the spectacular Alaska. His aeroplane is piloted across the Cradle of the Storms to land safely in the caldera of Aniachak. His party traverses the Valley of Ten Thousand Smokes, the Dragon's Nest, the Ghost Forest, and other excitingly named wonders, but all possible obstacles are met only to be successfully overcome.

This is an exciting book and gives a vivid account of the south-western peninsula of Alaska; its illustrations are beautiful. It is not a scientific work but it should have a wide appeal to all

lovers of stories of exploration and of adventures where "one false step means death."

In an appendix by the field manager of the party, one is surprised to read under the heading, "Medicine Kit," the following: "We have never been sick during our many years of exploration and in our Medicine Kit we take only iodine, tape, and a few bandages."

J. A. MORRIS.

The Next Hundred Years. By C. C. FURNAS. (Cassell. 8s. 6d.)

As he studies the opening chapters of this book, the reader has an uneasy feeling that the author regards himself as chosen by the God of Efficiency for the part of the voice crying in the wilderness of ignorance, reaction, and greed. References to "that thing which passes as public intelligence" are not entirely happy.

But as Mr. Furnas proceeds with his ambitious task of cataloguing the unfinished business of science, the reader realises that he speaks of the shortcomings of the world to-day not so much in sorrow or in anger as in a realisation that the way in which mass inertia and vested interests obstruct the coming of the perfect civilisation are no less interesting and instructive than the way in which he himself would achieve it if he had the power.

He deals fully and clearly with every department of science and industry, explaining what has gone wrong, how it could be made to come right, and why it will not come right for a long time. No one could read the thirty chapters without coming to a fuller realisation of the complication of this 20th century world, or of the puny bite which man has yet taken in the apple of knowledge.

The book is American, and not free from misplaced flippancy. In the course of a disquisition on synthetic foods, the author writes: "We are physiologically equipped to enjoy a full stomach. The hostess likes to hear the vest buttons popping." But his light touch is often very clarifying. On the subject of rust mines, he explains, "for millions of years microbes gargled dilute iron water in the swamps of Minnesota and Michigan, concentrated it, and left it behind in their skeletons." Then Mr. Furnas is virile in despair, where many technical writers are merely depressing. On seeing three-quarters of the Federal Budget going to War costs, and only 0.5 per cent. to scientific research, he writes, "Temporarily, at least, I lose all the patriotism I ever had. It is a great age—choose your poison and get in step, 500 years behind the technical advancement of our times."

The Revolution in Physics. By ERNST ZIMMER. (Faber and Faber. 12s. 6d.)

The author of this fascinating book is concerned to trace the developments in the physical conceptions regarding matter and radiation which have occurred within the last few years and to represent them in such a manner that the intelligent layman shall gain an insight into the profound changes in the mental outlook which have taken place. In this historical survey the author deals firstly with the nature of matter and radiation according to classical Physics, the discovery of the nature of X-ray radiation being one of the final triumphs of this era.

The revolutionary concepts of Planck concerning radiation and their application by Bohr and others to the theory of the

atom and atom-building generally are then discussed in an illuminating chapter. One is bound to admire the skill which the author displays in painting his picture; the illogical coupling of classical and quantum ideas whose main justification was the success attending such mating; the growth of the mechanistic models of the atoms and finally that segregation of problems of radiation and emission into classes, one requiring wave, the other corpuscular, characteristics.

In the second part of the work he deals with the attempts of Heisenberg, Schrödinger and others to resolve this dilemma. There is a particularly helpful chapter dealing with the interpretation of matter waves, and the book concludes with a short discussion on the implications of the principle of uncertainty in the realms of philosophy. The style is exceedingly fresh throughout and it is remarkable how well the author has succeeded, without using any mathematical analysis, in giving so clear an outline of the efforts made during the past few years towards a fuller understanding of natural processes. The book is emphatically one, not only for the general reader, but for the serious student of physics, and it can be most cordially commended.

You and the Universe. By PAUL KARLSON. (Allen and Unwin. 12s. 6d.)

Never has a more humorously explicit guide to the profundities of modern physics been written than *You and the Universe*. The layman will have great difficulty in finding another book which covers so much ground and explains so clearly the most difficult as well as the most elementary physical theories.

Dr. Paul Karlson studied mathematics at Berlin University but later turned to physics under Planck, Laue, and Schrödinger. He has also made a particular study of Eddington's theories.

His book, originally published in Germany, is illustrated by photographs and by many humorous drawings by W. Petersen. It is at first surprising, but soon illuminating, to see molecules in the shape of little animals performing evolutions that are equally humorously described in the text.

Dr. Karlson starts by explaining the structure of the universe, the meaning of energy and impulse, and the properties of matter. The next section of the book is devoted to an analysis of electricity and magnetism. This leads to the subject of light-waves, light-quanta, and the theory of relativity. Many popular misconceptions in this respect are elucidated. Finally, he discusses what he calls "The New Ideas," and in this section alone, as he confesses, the subject becomes bewildering to the layman.

Man Makes Himself. By V. GORDON CHILDE. (Watts. 7s. 6d.)

This book is difficult to classify. Its subject is no more the history of archaeology than it is the history of science. It is rather a general history of the cultural development of man. The author mentions archaeological evidence but does not enter into a discussion of pedantic and technical differences of interpretation which, as he suggests, only confuse the general reader.

Mr. Childe draws a picture of man in his earliest state and explains clearly how gradually culture developed and how the force of economic and other circumstances brought about various revolutions in the modes of life adopted. There is a most interesting and revealing chapter on time scales. The reader is asked to remember the great changes that have taken place in the last thirty years. Then he is asked to imagine

conditions of life three hundred years ago, and to remember that any thirty years in that three hundred was comparable to the last thirty years in the changes that took place. And so he brings us back three thousand years and then three hundred thousand. I would suggest that readers should turn to this chapter before they begin the book.

Wild Flowers of the Wayside and Woodland. By T. H. SCOTT and W. J. STOKOE. (Warne. 7s. 6d.)

The authors of this work have taken as a foundation for their book Edward Step's standard work, *Wayside and Woodland Blossoms*. They evidently felt there was a need for a smaller edition, in the form of a pocket guide, to enable those lovers of nature, rambles and students, to be further enlightened on the loveliness and mysteries of the wild flowers of our countryside. For it is not until one digs deeply into this interesting study that one can realise the beauty of some of our commonest wild flowers.

The most striking feature of this book is the coloured plates and the pictorial colour guide, which will be found invaluable to the keen student of botany; added to which the description of the plants is so lucid that one cannot help acquiring knowledge of the wild flowers in an easy manner, as well as very quickly identifying any particular plant. Many of the illustrations have been taken from Edward Step.

This book can be used also as a stepping stone to more serious works on our flora; the information contained in it will have awakened the enthusiast's interest to such an extent that he will probably go further into the fascinating study of wild flowers. The glossary and index, together with the classified list of natural orders, genera, and species, add to the value of this admirable companion and guide.

A History of the Greek World from 479 to 323 B.C. By M. L. W. LAISTNER. (Methuen. 15s.)

There is no more dramatic an era in all history than that of the Greek world, from the failure of the Persian invasions of Europe to the triumphs of the Greek Alexander over Persia and all her domains. The century and a half abound in great men and great deeds that have stirred the imagination ever since; and the record is marred by stupendous crimes and follies that have provided texts for moralists during some two thousand years without much visible effect on the behaviour of political man. Professor Laistner's sketch of this astonishing period, in a new volume of Dr. Cary's admirable *History of the Greek and Roman World*, is precisely what many readers want, namely, a compact survey of events with a short account of Greek institutions, literature and art in which due note is taken of the new inscriptions and other discoveries which throw light on the familiar narratives of Thucydides, Diodorus, and Arrian, Professor Laistner is, of course, hampered by lack of space. Not for him are the magnificent speeches in which Thucydides set forth the reasons for and against the destruction of the Melians or the expedition to Sicily. Nor can he enlarge on the character and aims of Pericles and Alcibiades, Nicias and Epaminondas, and other famous Greeks; even Alexander himself has to be treated summarily. Nevertheless, the author contrives to give a fair idea of the more notable men, in an age in which individual personality counted for

more, perhaps, than at any other time known to us, and his judgments, however brief, are clear and arresting. On the main question, whether the collapse of the many small city states before the Macedonian monarchy was to be regretted, Professor Laistner is distinctly unorthodox. He will not shed tears over those little states, Athens, Sparta, Thebes, Corinth, and the rest, whose interminable quarrels brought misery to themselves and their dependents and weakened Hellenism. On the contrary, he thinks that Philip II of Macedon, despite the denunciations of Demosthenes, was a true benefactor to all the Greeks when he compelled them to recognise his supremacy and thus enabled his son Alexander to direct the forces of a united Greece against the Persian and spread Greek civilisation into Central Asia and Upper India, as well as into Egypt. The Athenian Empire at its height was but a small affair in comparison with the Macedonian, and the special interests of Athens predominated over the welfare of her allies and subjects. The brilliancy of her intellectual achievements in the age of Pericles must not blind us to the narrow parochialism of her policy, as determined all too often by the blind passion of an unstable democracy. The story of Athens in her prime can never fail to interest, but rather by way of warning than as a model for statesmen.

Professor Laistner's valuable chapters on Sicily show how the Greek cities there and in southern Italy exaggerated the selfishness of the city-states in Greece, whose colonies they were, and thus engaged in interminable wars which ultimately made them an easy prey for Rome. His compact narrative of Alexander's conquests is particularly clear, and stresses the great king's humanity and his freedom from racial prejudices. As compared with the inter-city wars, in which the defeated foes were either massacred or sold into slavery, Alexander's campaigns, as a whole, were free from brutality, except indeed at Tyre. This aspect of the conqueror's character was not lost in later ages, and helps to account for the great popularity of the Alexander legend in mediæval Europe, which looked upon the Macedonian as a paragon of chivalry. The author's chapters on government, religion, art, literature, philosophy, and economic life in fifth-century Greece are necessarily brief but serve as a useful introduction to a vast subject and round off an excellent book.

The Mesolithic Settlement of Northern Europe. By J. G. D. CLARK. (Cambridge University Press. 25s.)

For a long time—long, that is, in relation to the comparatively brief history of archaeological studies—it was thought that a gap intervened between the Old and the New Stone Ages, during which man retreated from northern Europe to return fully-fledged as neolithic man, equipped with pottery and domestic animals and a knowledge of agriculture. Recognition of facts irreconcilable with that view at first proceeded slowly, but none the less with certainty; and the increase in knowledge and understanding of this intervening period during the last ten or fifteen years has indeed been remarkable. In this advance Mr. Clark himself has been one of the foremost.

An indication that the uncertainties, which invariably attach to the initial stages of any archaeological reconstruction of far-reaching effect, have not yet been eliminated finally from this intervening period is afforded by the fact that archaeologists are not yet in complete agreement as to either its name or its essential character. Some would regard it as a continuation in

attenuated form of activities fundamentally developed by palæolithic man. They, therefore, prefer to term it "epi-palæolithic." Others regard it as essentially transitional, and call it "mesolithic." Mr. Clark, while preferring the latter term, explicitly negatives the implication of transitional. The period is here treated as a phase of individual development, having a definite and specific character. Not, indeed, that he does not recognise that the mesolithic has affinities with the palæolithic and elements which survive into the neolithic; but he differentiates three cultures, which warrant a division of the period as a unit into phases which are concomitant with changes in climate, in relative distribution of land and water, and in vegetation. Of these cultures, the third, the Tardenoisian, ultimately derivative in all probability from Africa, to a great extent lies outside his territory, but the remaining two, the tanged-point and stone-axe cultures, are characteristic, the latter developing in response to the increasing prevalence of forest conditions as climate changes.

In arriving at his classification of mesolithic cultures, Mr. Clark has made a detailed examination of finds and sites from one end of Europe to the other. And in his chronology and his evaluation of the effects of climatic and geographical environment he makes full use of the results of recent investigation in the auxiliary sciences of geology, palæontology, and palæobotany, which can be brought to bear upon the archaeological problem and more especially on the question of dating. In this connection it is interesting to note his opinion that Northern Europe, which, up to only a short time ago, was dependent for its dating on estimates based upon calculations derived from the areas of the great civilisations, as the result of investigations now proceeding may be in a position before very long to return the compliment by itself providing the material for a positive and absolute chronology of world-wide application.

British Calendar Customs. By A. R. WRIGHT. Vol. I: Movable Festivals. (William Glaisher, for the Folklore Society. 13s.)

If English folklore is poorer than that of its immediate neighbours by the absence of any considerable saga or collection of legendary lore, such as the *Mabinogion* in Wales, and the heroic cycle of Ireland, it can hold its own in that sphere of little less importance for the analysis of cultural history—the body of customs and observances which cluster around the crucial points in the calendar. In England the record is indeed rich, and affords a field in which it is easy to see how such a distinguished scholar and folklorist as the late A. R. Wright could find a life-work.

In the present volume the editor presents a selection from the material collected by Mr. Wright, dealing with such movable feasts of the year as Shrovetide, Lent, Easter, and so forth. To these some of the familiar harvest customs are added.

In this special group, it will be noted, the pagan elements are usually to be discerned, but transformed by the ritual of the Christian calendar which has been imposed upon them. In the feasts of fixed date, which are not touched upon here, except in, for example, Christmas and a few others where there has been assimilation, the pagan element is more prominent, even if it does not predominate, as in the May Day celebrations.

Mr. Wright's material was drawn from a wide variety of sources, which differed greatly in authority and authenticity. It might, perhaps, have been wise to show a little more discrimination in the editing of the volume. Gratitude for its publication, however, precludes too exacting a standard.

August, 1936

developed by
in it "epi-
ditional, and
latter term,
The period
it, having a
he does not
palaeolithic
e differenti-
period as a
s in climate,
etation. Of
y derivative
outside his
d stone-axe
response to
ate changes.
cultures, Mr.
d sites from
ogy and his
cal environ-
stigation in
alaeobotany,
cal problem
n this con-
ern Europe,
or its dating
the areas of
ow proceed-
the compli-
nd absolute

I : Movable
ore Society.

mediate neigh-
r collection
es, and the
ere of little
—the body
the crucial
indeed rich,
ow such a
R. Wright

ection from
ch movable
nd so forth.
e added.
lements are
itual of the
em. In the
e, except in,
re has been
e, even if it
ions.
y of sources,
r. It might,
mination in
on, however,